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PIPE LINE INDUSTRY

Gulf Publishing Company

APRIL
1958

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APR 25 1958

LOWER COST STATIONS
Tapline's Turbines Mark Many Firsts 43

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Make Every Man a Safety Director 77

For a "Quick Look" at this issue, turn the page .

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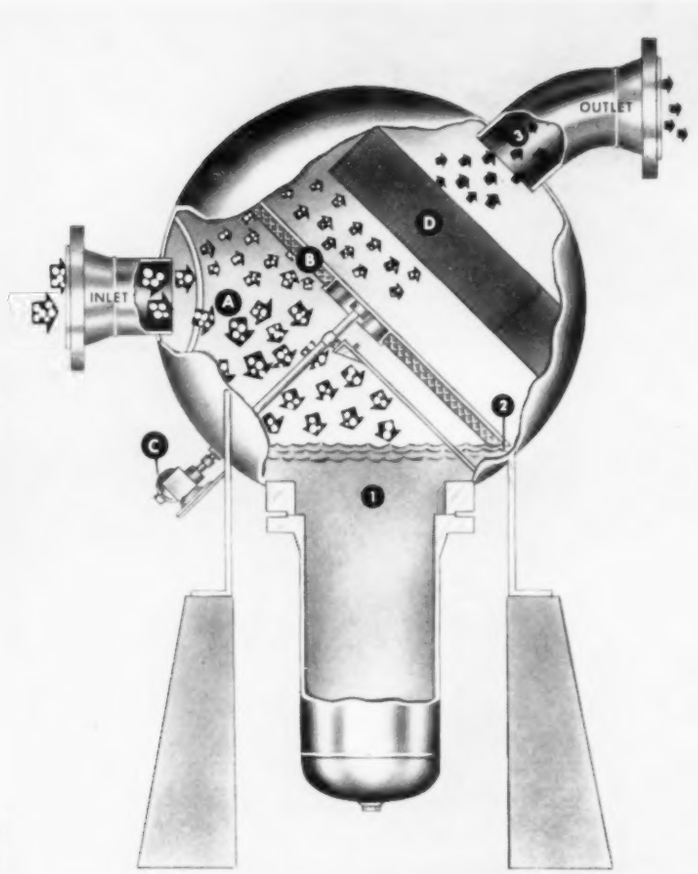

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The majority of incoming liquid (A) and solid particles are directed to either side and down into reservoir (1). Lighter solid particles carried by gas stream are separated on surfaces of contactor (B) which are kept wet and clean by revolving thru liquid reservoir (2). Contactor is revolved by explosion-proof gear motor (C). Mist Extractor (D) removes any remaining liquid particles from gas stream prior to outlet (3).

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PIPE LINE INDUSTRY

CONTENTS and Quick Look

April, 1958 Vol. 8, No. 4

To help you put first things first, scan these time-saving digests, checking √ those you want to read first.

Outstanding Reports from the American Petroleum Institute's Division of Transportation meeting

Tapline Boosts Capacity With Turbines

☐ Design and engineering of these unattended, remotely controlled main line pumping stations feature several innovations. Units at three auxiliary stations are installed in vans providing maintenance and operating flexibility that make them virtually "portable." The 5,000-horsepower, oil-fueled gas turbines drive pumps directly at speeds between 5,000 and 6,000 revolutions per minute. Investment costs per horsepower are one-sixth that of existing manned desert stations. Here is a comprehensive report on installation and initial operating tests.

By W. E. Locher, A. E. Olson and P. P. Nibley Page 43

The Growth of Automatic Custody Transfer

☐ Lease automatic custody transfer has an almost unlimited potential to net good profits to the petroleum industry. Only through firm initiative and leadership of both producing and pipe line companies can the savings be realized. Statistical data collected on the present status of LACT shows the rapid increase in installations in recent years.

By A. H. Hall and H. L. Shatto Page 52

Dispatcher's Role in Controlling Expenses

☐ A dispatcher's duties involve more than just directing line flow. Know-how in considering power costs, equipment usage, manpower costs, scheduling scrapers and planning for emergencies are important ways a good dispatcher improves operation and reduces costs.

By Fred M. Springer Page 58

Gilsonite Line Marks First Year of Operation

☐ Design and operation of American Gilsonite Company's 72-mile 6-inch slurry pipe line have confirmed research findings of pilot flow and pumping studies. First year's experience shows a volumetric efficiency of 95 percent with a pumping rate of 350 gallons per minute when handling a slurry with solid concentration of 32.5 percent. Slurries with solids content as high as 40 percent have been handled with no loss in volumetric efficiency. Friction factor is about the same as that of water; solids recovery with negligible particle attrition is virtually 100 percent. Out-of-pocket cost of moving gilsonite by pipe line is only 2.5 cents per ton mile in first year of operation.

By John H. Henderson Page 61

Cost Analysis in Pipe Line Design

☐ Here is a comprehensive summary of basic engineering economics that will help you determine the optimum system design. Graphical cost data on station site selection, power costs, line sizing and future looping economics can give quicker and more accurate estimates.

By Dave Vondy Page 66

$1 Million Investment in the Future

☐ Your acceptance of PIPE LINE INDUSTRY has made it possible for the magazine to set new records in circulation and advertising since 1954. You, the subscriber, have been the key factor in our growth, so we want to share this outstanding example of our progress with you Page 74

Make Every Man a Safety Director

☐ By rotating regular inspections among division personnel, Interstate Oil Pipe Line Company keeps a fresh slant on safety. Actual field conditions are discussed during the monthly safety training meeting. Practical solutions result in elimination of hazards... Page 77

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A hazardous risk

THE PRESSURE for sizable reductions in U. S. oil imports has grown substantially and enthusiastically in recent weeks. The reason is as clear as it is simple: U. S. crude oil production is shrinking in the midst of plenty as imports remain on a relatively high level.

And these ills are fast developing in a period when, for the benefit of the entire nation, every industry which can remain healthy in and of itself should be permitted that freedom of success.

U. S. crude oil production in March will be 1⅓ million barrels or 18 percent less than in March, 1957, and at its smallest volume since 1954. Despite government voluntary curbs, imports of crude oil during the four weeks ended March 14 (latest available figures) were 50,900 barrels per day or 3.5 percent greater than in the corresponding period of 1957, and 201,000 barrels per day or 30.6 percent larger than the daily average in 1954. In addition, imports of refined products have risen 36,900 barrels a day or 5.8 percent since a year ago, and 271,000 barrels or 68.5 percent above the average for 1954. Imports of refined products have just as much impact on the domestic market as crude oil imports.

At this point, the President ordered an additional 58,000 barrels per day reduction in imports outside of the West Coast. It is doubtful if this will alleviate any demand for curtailment of imports. The reduction is too small to prove of much benefit to U. S. producers.

With reason, therefore, domestic producers feel it is not fair or equitable for U. S. production to be curtailed so drastically without corresponding reductions in imports.

Mandatory controls are being sought by a growing segment of the U. S. producing oil industry. An increasing number of producers see mandatory or compulsory controls as the only means of enforcing a reduction in imports. Their fears are intensified by more and more companies asking for import quotas. At least 18 companies who now do not have import quotas have made applications to import approximately 132,000 barrels of crude oil daily.

Many who heretofore have favored high tariffs as the best means of curbing imports now favor mandatory controls. Apparently, this is because there appears to be little possibility of getting Congressional and presidential approval of higher tariffs. Therefore, as a last resort, producers are demanding that compulsory controls be enacted either by Congress or presidential edict. Many favor the former, seeing it as the only way they are likely to procure a permanent stable import basis.

This is a dangerous course, which until now even domestic producers have hesitated to advocate. Oil imports should be curbed. The need is obvious. Imports should not be permitted to supply an increasing portion of the U. S. consumption when domestic production is being curtailed so drastically.

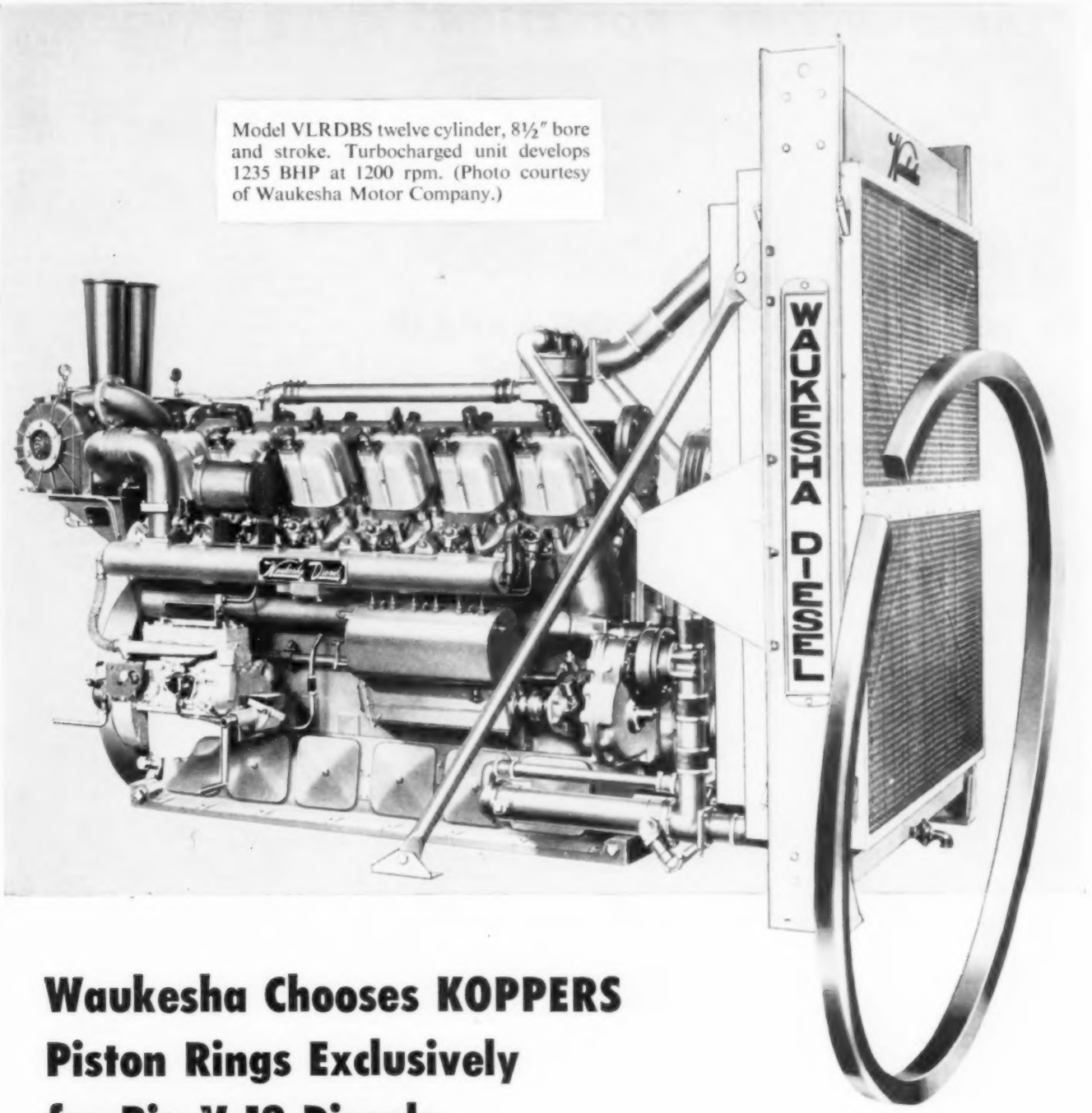
However, mandatory controls are a certain step in the direction of federal control of the domestic oil industry, as well as of imports. Once imports are controlled, there will be demand for equitable regulation of producing rates between states. Some states have been increasing their production, while others, notably Texas, have curtailed their output. Some states prorate to various degrees, while others do not.

Allowables between states can be fixed only by federal control. The federal government never turns loose of anything it gets its hand on. Instead, each bureau inevitably endeavors to increase the scope of its power. The government will be willing to take on the task of regulating U. S. production.

The position of domestic producers is readily understandable. Many of them recognize the danger, but in their present desperate crisis see this hazardous risk as the only way out of their dilemma.

However, mandatory controls are fraught with such danger of complete government control, it behooves all segments of the industry (domestic producers, importers, pipe line, refiners etc.) to do everything in their power to avoid compulsory control. Each should be sufficiently conscious of his national responsibility to see that a satisfactory answer is found to the import problem which would avoid government control. The industry must be kept free of federal government shackles.

Warren L. Baker



Model VLRDBS twelve cylinder, 8½" bore and stroke. Turbocharged unit develops 1235 BHP at 1200 rpm. (Photo courtesy of Waukesha Motor Company.)

Waukesha Chooses KOPPERS Piston Rings Exclusively for Big V-12 Diesels

Waukesha's VLRDBS supercharged diesels are perfectly suited for applications such as oil rigs, excavators and tugboats where a surge of reserve power is essential for emergency and overload demands.

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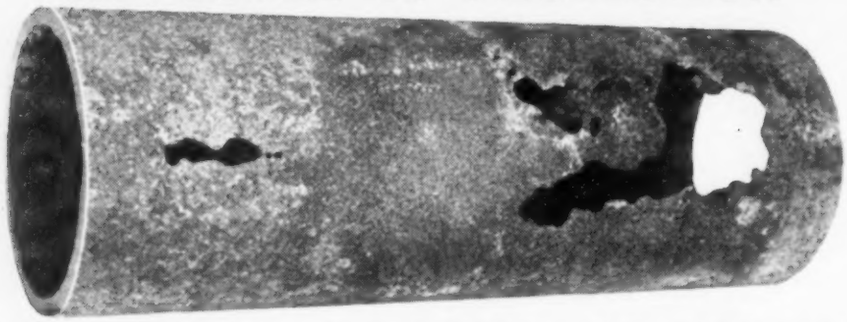

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SPECIFICATIONS							
	IF-3	IG-3	IGF-3	IXF-3	IXG-3	2F-3	2GF-3
Steel Grit Cleaned	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1	Primer	Primer	Primer	Primer	Primer	Primer	Primer
2	2/32" Enamel	2/32" Enamel	2/32" Enamel	2/32" Enamel	2/32" Enamel	2/32" Enamel	2/32" Enamel
3	1/32" Enamel	Glass	Glass	1/32" Enamel	1/32" Enamel	1/32" Enamel	1/32" Enamel
4	Asbestos Felt	1/32" Enamel	1/32" Enamel	Asbestos Felt	Glass	Asbestos Felt	Glass
5	Kraft	Kraft	Asbestos Felt	X or Seal Coat Enamel	X or Seal Coat Enamel	X or Seal Coat Enamel	X or Seal Coat Enamel
6			Kraft	Kraft	Kraft	Asbestos Felt	Asbestos Felt
7						Kraft	Kraft

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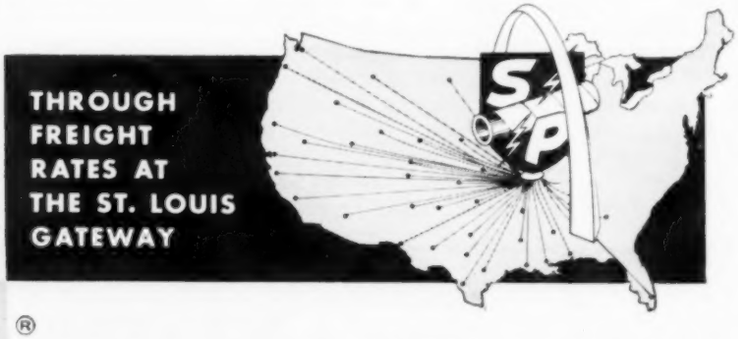
Pipe once underground, becomes most expensive to dig up and repair or replace. Make sure your pipe stays down by specifying SPI coating and wrapping. Choose any of many specifications.



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Indexed by Engineering Index

NOT EVEN FIVE FEET OF PEAT BOG CAN HANG UP THE NO. 583

The Cat* No. 583 Pipelayer is not only the highest capacity pipelayer in history—but the most efficient. Mannix Ltd., Calgary, Alberta, has four of them in its 100% Caterpillar spread laying 110 miles of 30-inch gas line through southern British Columbia.

The line takes the No. 583s through 40 miles of reclaimed lake bottom, covered with heavy silt and peat bog four to six feet deep. But the No. 583 has a full 21-inch ground clearance, and the bog can't stop it.

These big yellow units were engineered to give you a full day's work no matter what the terrain. For this machine was designed after consulting spread superintendents, foremen, mechanics and operators throughout the industry. It incorporates all their ideas of the ideal pipelayer. As a result you have the first machine that is *all pipelayer*.

It has 130,000-lb. lifting capacity and its engine delivers 191 HP. There is a three-stage torque converter in the main drive and new hydraulically actuated counterweights. And the extra high bottom clearance of the counterweight pivot, coupled with the ability to retract the counterweights well over the tracks, means that the No. 583 can maneuver easily even while handling an extra heavy load on a narrow right of way.

Here's the safest, fastest, most efficient machine ever designed for pipelaying. Behind it stand an army of Caterpillar Dealers always ready to give you quick service with quality factory parts wherever the pipe takes you. Call your Caterpillar Dealer today. You name the date—and he will demonstrate on *your* job.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

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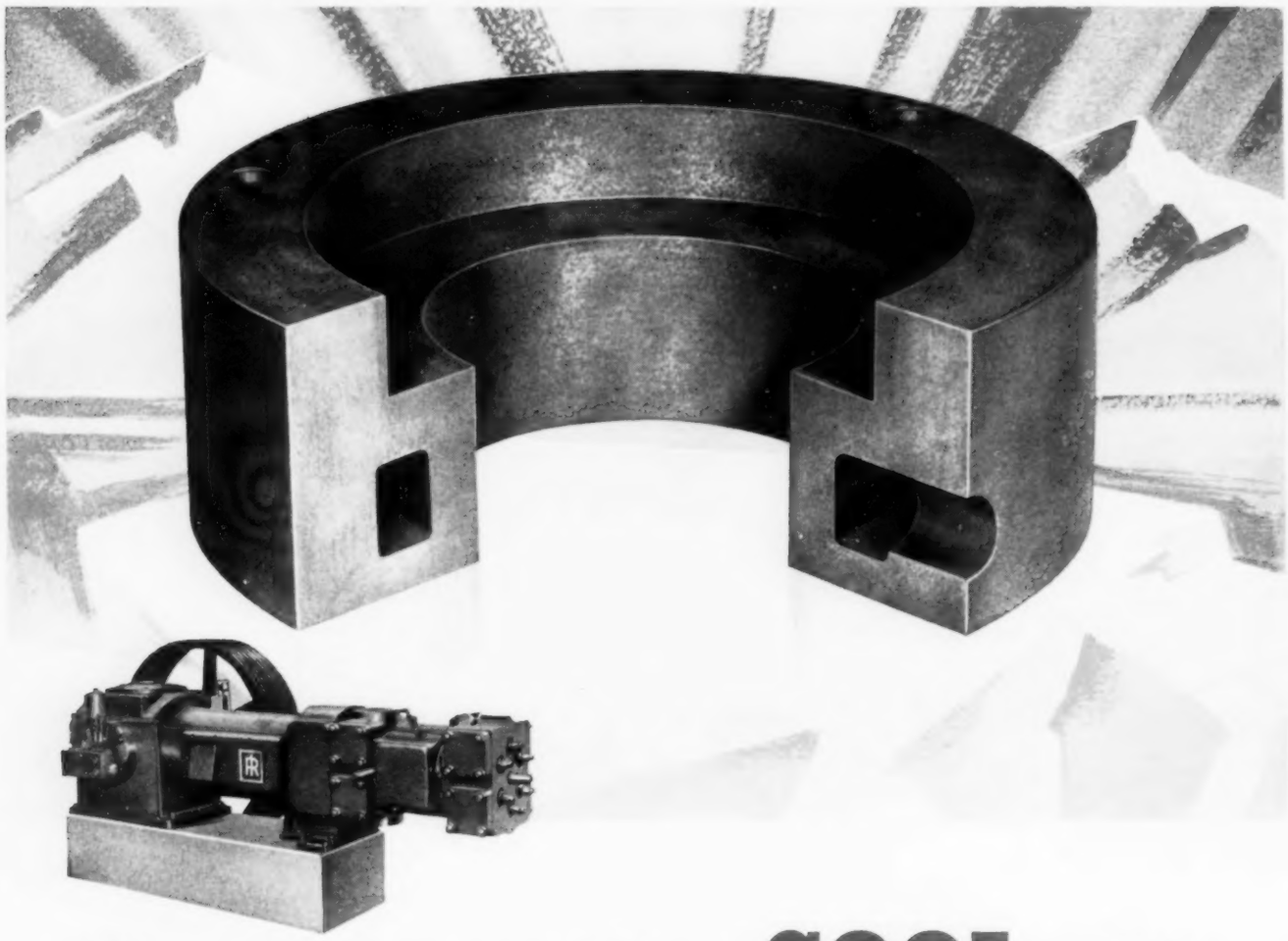

Keep your packing COOL with this leak-proof Cook packing cup!

CHANCES are you've never seen anything like Cook's water-cooled packing cup, as shown above with one of Ingersoll-Rand's new ESH compressors. That's because it's new, *with a leak-proof construction that's exclusive with Cook!*

Water circulates around the *inside of the cup itself*, in a completely self-contained channel. This eliminates any possibility of leakage, corrosion, or contamination of the material under compression. These are big advantages for all applications —and are naturally of even *greater* importance for non-lubricated service.

Write direct today for full details about this revolutionary new water-cooled packing cup. Address: C. Lee Cook Company, 944 South Eighth Street, Louisville, Kentucky.

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Available in nominal sizes from 4" through 24"... in wall thicknesses of .188, .219 and .250 inch. Also, 125 lb. light weight taper face welding neck flanges in sizes 2"-12" inclusive.

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A typical user of light weight steel piping reports these benefits:

- 100 feet of 8″ x .188″ wall pipe costs about $10 less than 100 feet of 6″ standard weight pipe
- Increases flow area 85%
- Cuts piping weight about 10%

To enable you to take full advantage of the economies of "thin wall" steel piping, Tube Turns offers a complete line of light weight fittings. They are forged from seamless pipe. Meet all code requirements. Uniform wall thickness and true circularity permit field cutting of odd angles. Available promptly from Tube Turns' Distributors in all principal cities. Complete details in Bulletin TT 867, free on request.

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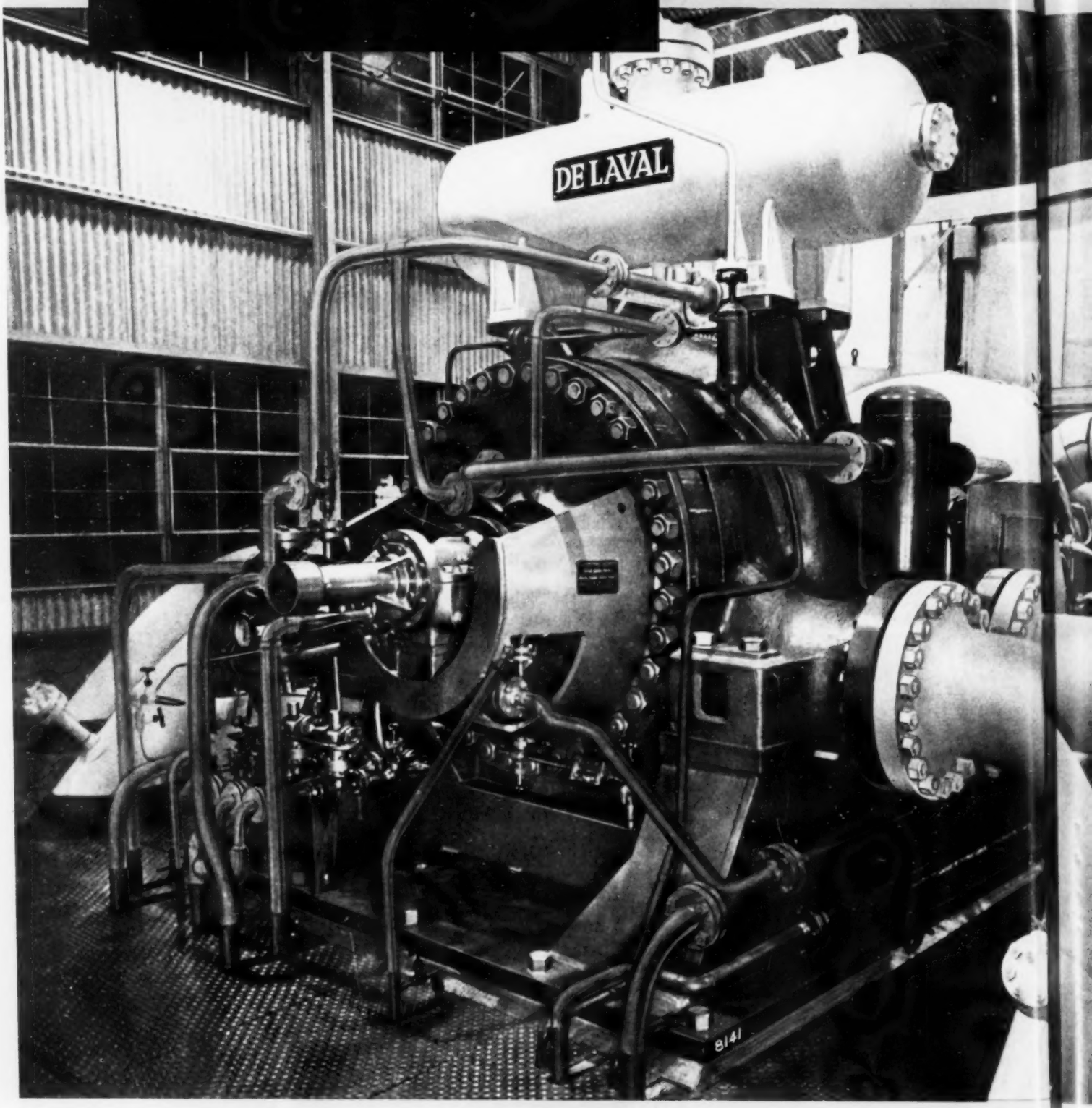
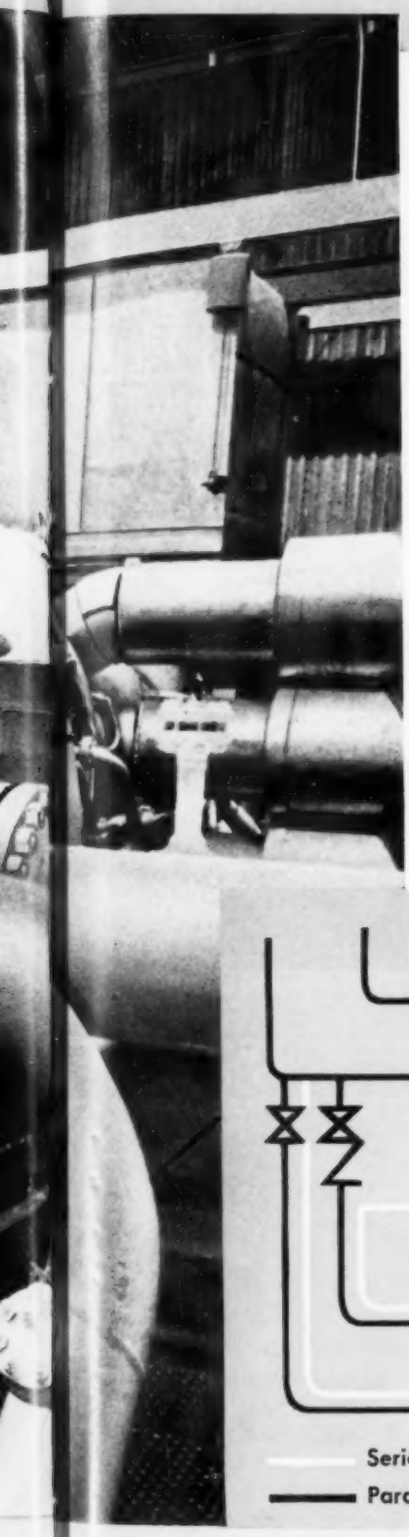
DE LAVAL
Series-Parallel
CENTRIFUGAL COMPRESSORS

provide extra fl



This De Laval Series-Parallel 6,350 hp centrifugal compressor is giving round-the-clock service in the Edna Station of the Trunkline Gas Company. Two other identical De Laval S-P units are doing a dependable job in the Kountze and Premont, Texas stations of this natural gas transmission system.

a flexibility for Trunkline Gas Company

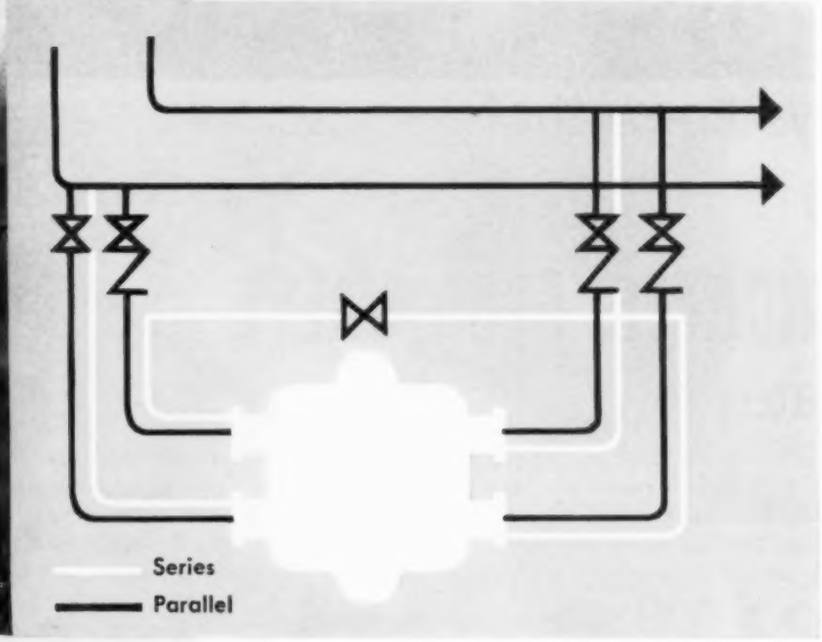


Booster station service demands flexibility in pipeline compressor design, which is available to a considerable degree in the standard De Laval single stage pipeline compressor. Some applications, however, require an exceptionally wide range, and the De Laval Series-Parallel centrifugal compressor has been designed to meet that need.

A good example is the De Laval Series-Parallel 6,350 hp compressor, shown in the photograph at left. It is one of three identical units serving booster stations of the Trunkline Gas Company.

S-P compressors are multi-stage units with the impellers arranged in two groups. Two inlet nozzles permit operating the impeller groups in series or in parallel as shown in the flow diagram. Within the horsepower limits of the driver, the compressor can be transformed from a high-flow, low-head machine to a low-flow, high-head unit *simply by operation of the external valving.* No changing of parts, not even a shutdown is necessary.

The reliability and economy of De Laval centrifugal compressors have been proved in natural gas transmission service throughout the country. You will find it pays to look to De Laval . . the company that has specialized in the development of these units. De Laval pipeline compressors are operating in sizes from 2500–15,000 hp and with all types of drivers—gas turbines, gas engines, steam turbines and electric motors.



For additional information, write for the article "Tailoring Centrifugal Compressors for Pipe Lines" as well as De Laval Bulletin 503.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
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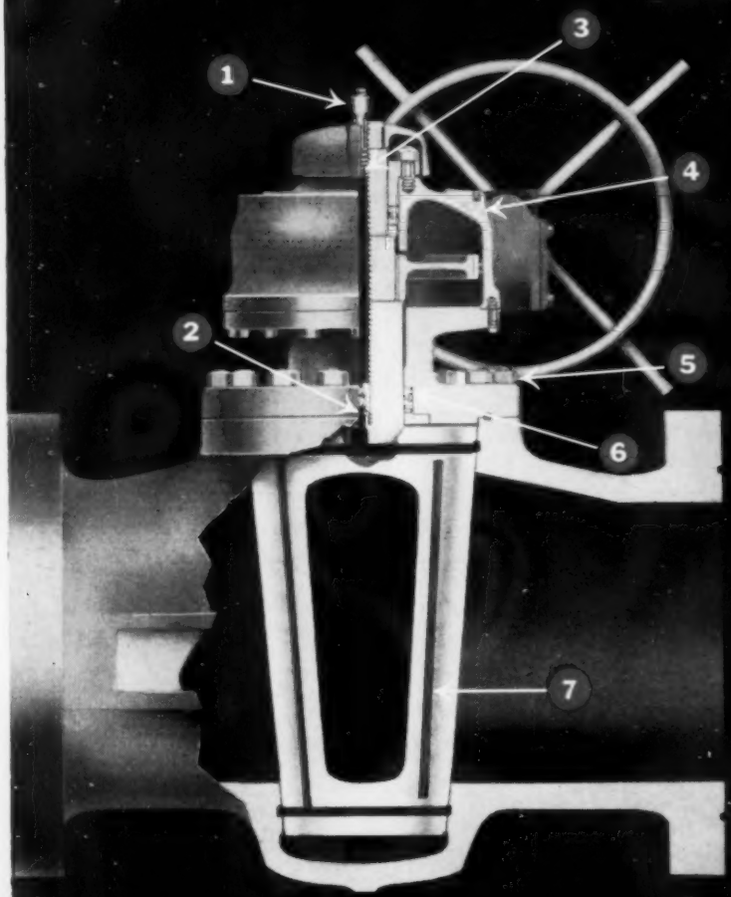
DL-399

7 characteristics that make WALWORTH a better Lubricated Plug Valve



1. Valve can be lubricated with a Walworth High Pressure Lubricant Gun without removing lubricant fitting.

2. Double ball check valve prevents line pressure from getting into lubricant system.

3. Groove, cut part way up side of lubricating fitting, provides extra safety feature by allowing operator to note any tendency of lubricant to blow out **before** fitting is entirely removed.

4. For buried pipelines—gear housing design permits simple attachment of lubrication and handwheel extensions without modifying the gearcase.

5. Standard bolt threads, rather than fine threads, means easy replacement of nuts and bolts from local stocks.

6. Two overlapping Teflon packing rings form an effective seal against possible leakage without "grabbing" the plug shank. Low break-out torque—plug turns easier.

7. Vertical and circumferential lubricant grooves completely frame the port openings, assuring a tight seal against leaks.

*Du Pont registered trade-mark

Cutaway of a 24-inch Walworth Lubricated Plug Valve

you always know that a WALWORTH LUBRICATED PLUG VALVE will operate

No matter when you need it, you can count on a Walworth Lubricated Plug Valve to operate easily and dependably in handling gas, crude or finished products. In petroleum service throughout the world, these valves have long proved their complete dependability and easy maintenance. Other Walworth products, designed and manufactured especially for the oil and gas industries, include Gate, Globe, Angle and Check Valves. Sold by distributors in principal centers throughout the world.

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MAINTENANCE

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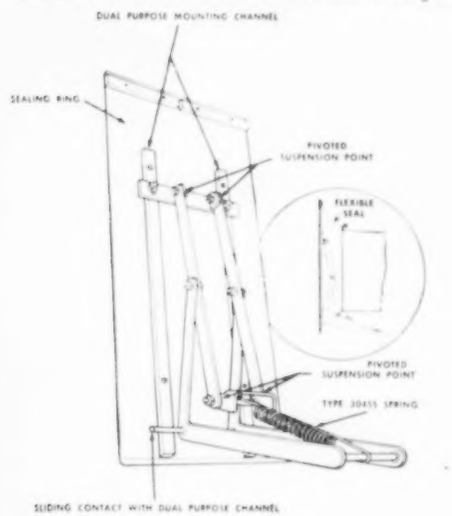

This exclusive Nooter 2-Point suspension seal hanger has one pivoted and one sliding point of contact with the dual-purpose mounting channel. This channel serves (1) as a means of attaching seal hanger to shoe without direct contact of seal hanger to shoe, and (2) as a method of providing even distribution of the forces of seal hanger over entire height of shoe.

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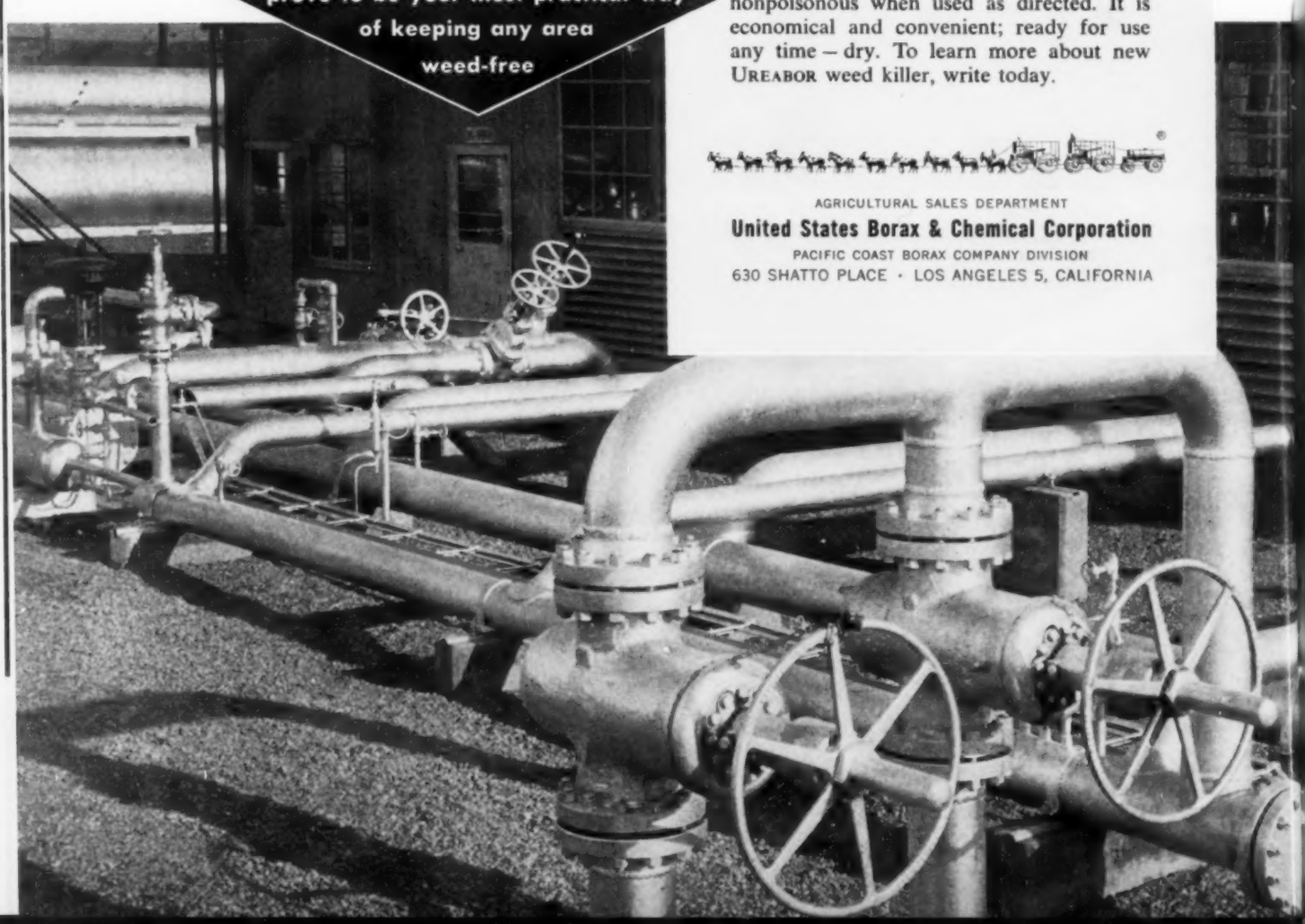
UREABOR weed killer is safe – it is nonvolatile, nonflammable, noncorrosive and nonpoisonous when used as directed. It is economical and convenient; ready for use any time – dry. To learn more about new UREABOR weed killer, write today.

This new chemical can prove to be your most practical way of keeping any area weed-free

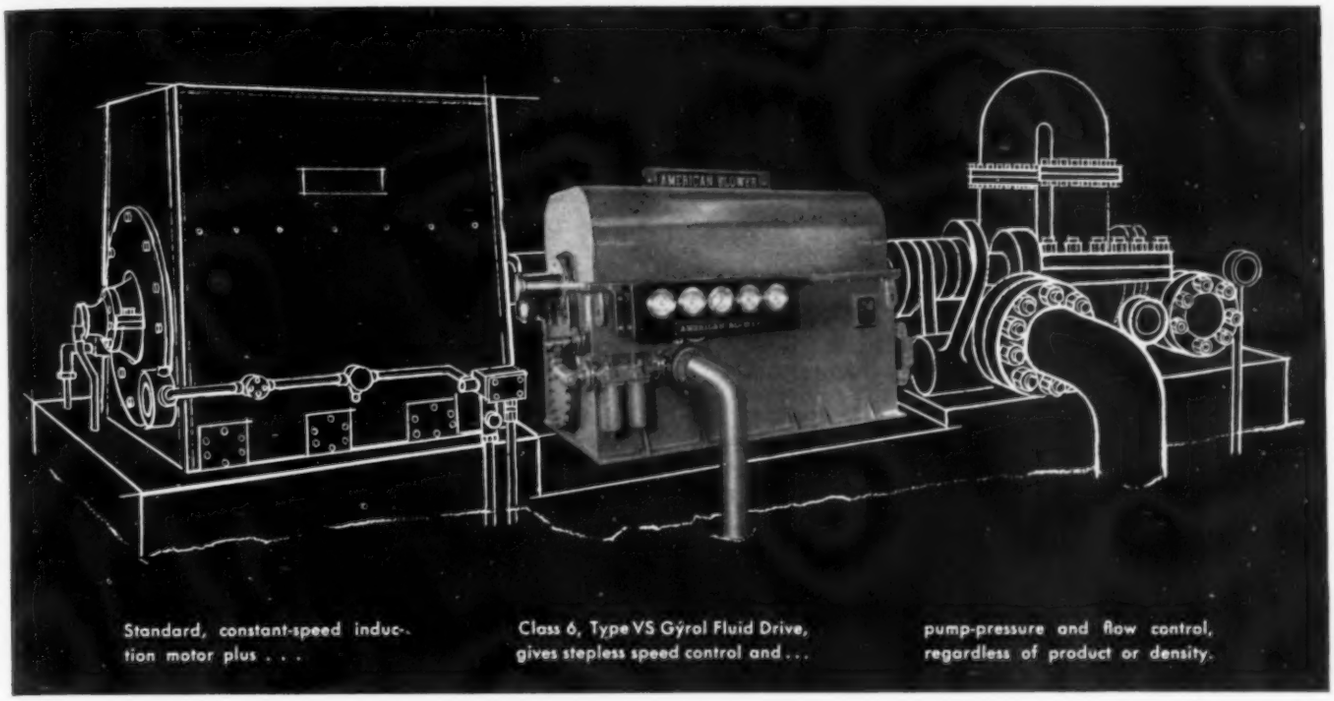


AGRICULTURAL SALES DEPARTMENT

United States Borax & Chemical Corporation

PACIFIC COAST BORAX COMPANY DIVISION

630 SHATTO PLACE · LOS ANGELES 5, CALIFORNIA



Standard, constant-speed induction motor plus . . .

Class 6, Type VS Gýrol Fluid Drive, gives stepless speed control and . . .

pump-pressure and flow control, regardless of product or density.

Lower your pipeline pumping costs with American Blower *Gýrol*® Fluid Drive

Stepless speed control ends throttling losses; gives complete flexibility of flow and pressure

Power savings up to 25% are possible when you equip centrifugal pumps with American Blower Gýrol Fluid Drive! Coupled with a standard, single-speed induction motor, the stepless, adjustable-speed Gýrol Fluid Drive controls flow and pressure without throttling; gives desired output at lowest power consumption.

Gýrol Fluid Drive also makes possible other major savings:

- Cost of throttling valve eliminated
- Equal flexibility with fewer units
- Lower maintenance cost; less pump wear
- No-load starting; lower demand charges

And Gýrol Fluid Drive brings important operating benefits:

- Complete flexibility—exact control, regardless of rate-of-flow required by changes in viscosity, specific gravity, seasonal demand
- Line protection—keeps line pressure within design limits
- Pump protection—holds minimum suction pressure

FOR FULL INFORMATION, contact one of our 73 branch offices; or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

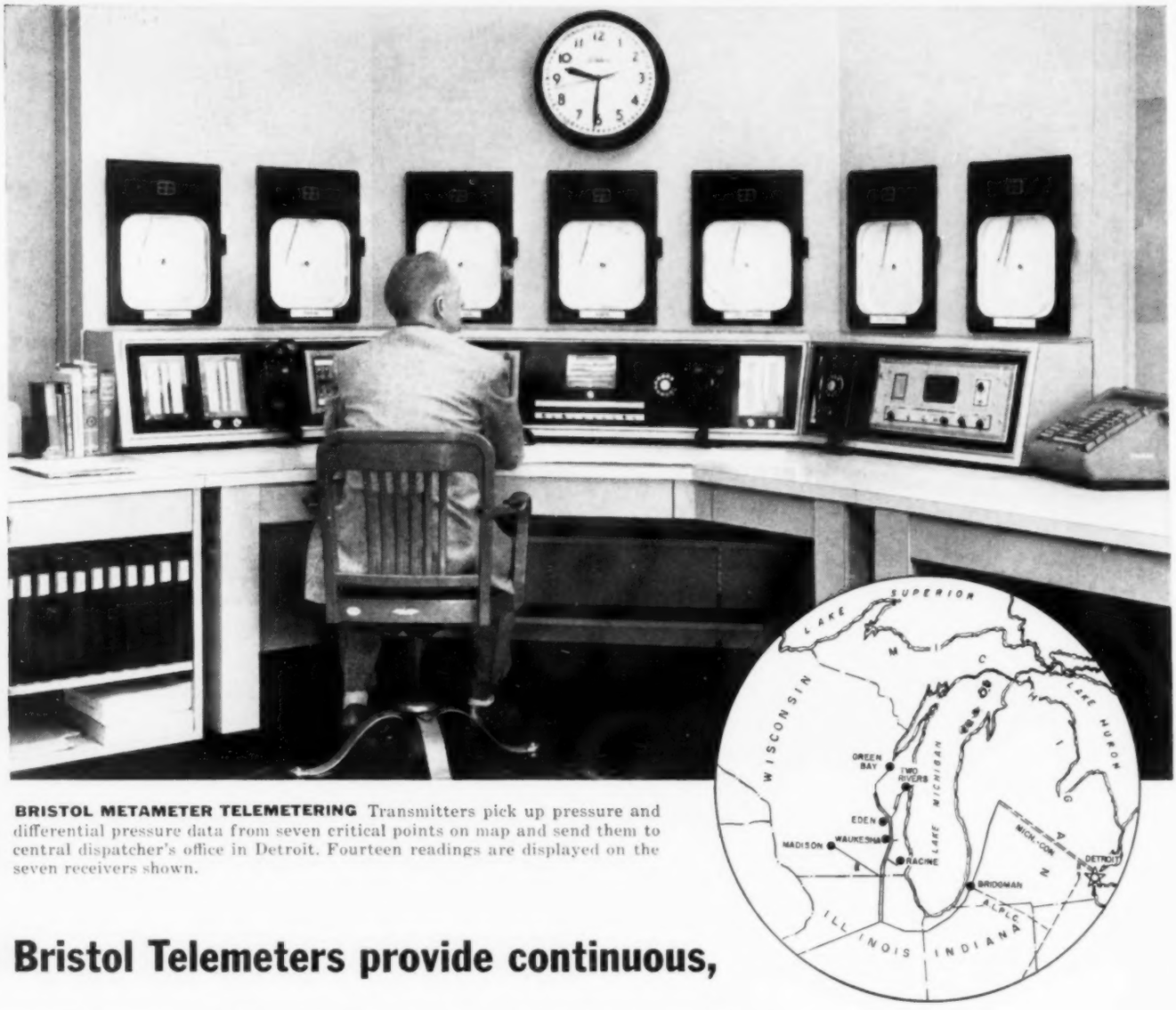
*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

American-Standard Products

AMERICAN-Standard

AMERICAN BLOWER DIVISION

For more data on advertised products, use Readers' Service Cards, last page.



BRISTOL METAMETER TELEMETERING Transmitters pick up pressure and differential pressure data from seven critical points on map and send them to central dispatcher's office in Detroit. Fourteen readings are displayed on the seven receivers shown.

Bristol Telemeters provide continuous,

automatic telemetering via privately owned microwave system

The Michigan Wisconsin Pipe Line Company, Detroit, Michigan, operates a 2000-mile Natural Gas pipeline network extending from Texas through nine states. A privately owned integrated microwave and VHF system provides voice and mobile unit communication service throughout the system.

It was a simple matter to add continuous automatic telemetering with Bristol Metameter* telemeters. Bristol telemeter transmitters send pressure readings from six locations in Wisconsin and one point in Michigan to the seven receivers (shown above) in the dispatcher's office in Detroit.

Although two individual voice frequency microwave channels are used for the fourteen readings, up to nineteen pressures could easily be simultaneously transmitted on only one voice channel.

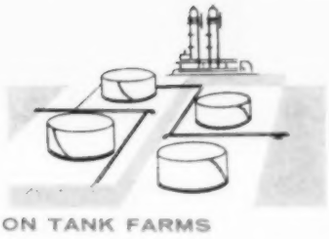
Find out how advanced Bristol telemetering systems can help your pipeline operation – whether over hundreds of miles or only a few hundred yards, whether over microwave or VHF radio, carrier current or leased wires. Ask us for details. The Bristol Company, 114 Bristol Road, Waterbury 20, Connecticut.

*T.M. Reg. U.S. Pat. Off.

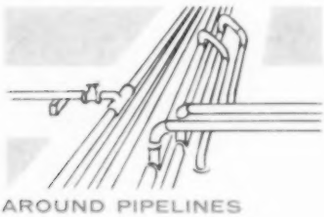
8-20

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



ON TANK FARMS



AROUND PIPELINES

AT WELL SITES

stop weeds and fires before they start

get preventive weed control with

GEIGY

SIMAZINE* 50W

pre-emergence residual herbicide with

Weed control is an old problem to the petroleum industry. Now Geigy's pre-emergence herbicide Simazine 50W provides a new and better solution – makes weed control *easier* because it is long residual; *safer* because of its Seven Safety Features; and *more effective* because it stops weeds before they start.

ONE APPLICATION PER SEASON

Simazine 50W reduces application costs in time, labor and material. At the rate of 10 lbs. per acre, one pre-emergence application controls annual grassy and broadleaf weeds for an entire season. At the rate of 20 lbs. per acre, one pre-emergence application controls most perennial weeds as well as annuals.

SEVEN SAFETY FEATURES

Oil maintenance men especially appreciate Simazine 50W's Seven Safety Features. This new herbicide is safe to humans and animals, non-flammable, non-corrosive, non-abrasive, and presents no conductivity problem or drift hazard. Check the panel for these and all of Simazine 50W's Seven Safety Features – and compare.

TECHNICAL SERVICE

Geigy Technical Service is readily available to serve you. Write for additional information, the name of your nearest Simazine 50W distributor, or ask to see a Geigy technical representative. Address: Geigy Agricultural Chemicals, P.O. Box, 430, Yonkers, N. Y.

7 SAFETY FEATURES

1. **SAFETY TO HUMANS AND ANIMALS**
   Extremely low toxicity. No need for protective clothing.
2. **SAFETY TO ADJACENT VEGETATION**
   Minimum lateral leaching. Remains where it is applied.
3. **SAFETY TO SPRAYING EQUIPMENT**
   Non-corrosive or abrasive to equipment.
4. **SAFETY NEAR ELECTRICITY**
   Relatively low electrical conductivity.
5. **SAFETY FROM DRIFT HAZARD**
   Works through roots – little or no toxicity to foliage.
6. **SAFETY FROM FIRE HAZARD**
   Non-flammable. No application hazard.
7. **SAFETY ON VALUABLE LAND**
   Not a permanent soil sterilant.

200 years Geigy

ORIGINATORS OF Geigy DDT INSECTICIDES

* "SIMAZINE" is a trademark of Geigy Chemical Corporation

GEIGY AGRICULTURAL CHEMICALS • *Division of Geigy Chemical Corporation* • Saw Mill River Road, Ardsley, N. Y.

Look...a complete farm

Type S 102-4 service regulator for settings 3½" to 15" W.C.
Type 1805 relief valve available for settings from 5 to 125 PSI.
Type 622 farm tap regulator for first stage pressure reduction will handle inlet pressures up to 750 PSI. Supplied with shut-off valve in body. Can also be supplied with regulator for pressures up to 1500 PSI.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

tap that's ready to hook up!

It's piped up. Now you have a complete assembly of the first stage regulator, relief valve and service regulator bucked-up complete with piping, ready to install. No more searching for individual items. No more building of the farm tap hook-up on the job.

It's pressure-tested. Fisher tests and sets the farm tap assembly at the factory.

It's completely packaged. The farm tap assembly comes in a sturdy carton assembled to your specifications. Cuts down the number of individual cartons and boxes it was previously necessary to haul around with you.

Think of the savings in time and manpower

Fisher has done much of the farm tap installation work for you. Fisher has cut out the wasted time looking for individual regulators—the cutting and threading of pipe to size—the assembly of the individual items. The packaged unit is available in a wide range of assemblies to meet your pressure or piping requirements. Fisher will tailor-make a farm tap assembly for your individual conditions.

It's another Fisher first. A complete farm tap that's ready to hook up.

Write for bulletin numbers P11A and S100 which illustrate and describe Fisher Farm Tap Equipment.

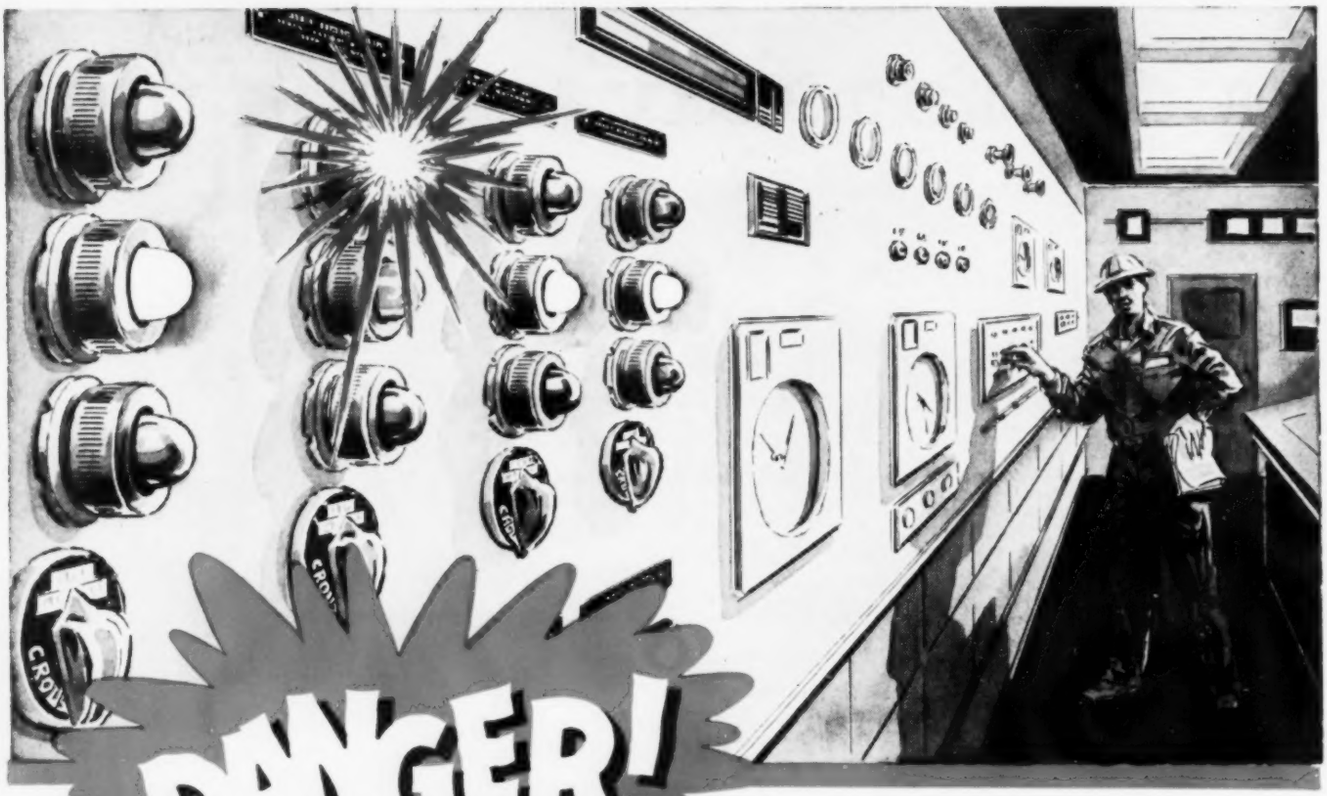
FISHER® Controls

SINCE 1880

FISHER GOVERNOR COMPANY

Marshalltown, Iowa/Woodstock, Ontario/London, England

For more data on advertised products, use Readers' Service Cards, last page.



. . . instantly signaled by Crouse-Hinds *Visularms*®

In oil refineries, chemical plants, synthetic rubber plants — wherever constant watch of processing is necessary — Crouse-Hinds Condulet® *Visularms* provide visual indication of process conditions, and instant control of manufacturing equipment.

By means of pilot lights (and bell, horn or siren signals where desired) *Visularm* indicates normal or abnormal temperature, liquid level, pressure, or other conditions which can be electrically coupled to the circuit.

Explosion-proof or dust-tight and weather-resistant construction* assures maximum safety in hazardous locations. Compact designs minimize space required on control or panel boards . . . are easy to install.

A Visularm system delivers substantial savings by eliminating the necessity for buying individual components . . . housing them . . . and wiring your own system completely.

Two- or three-light styles may be mounted either vertically or horizontally. For audio warning, any number of *Visularms* may be used to operate a single horn, bell or siren.

Visularms are just one of hundreds of items in process control board equipment offered by Crouse-Hinds. Only a few are shown at left. For full information on the complete line, call your nearest Crouse-Hinds distributor, or write . . .

*Dust-ignition-proof.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

Main Office and Factory: Syracuse, N. Y.
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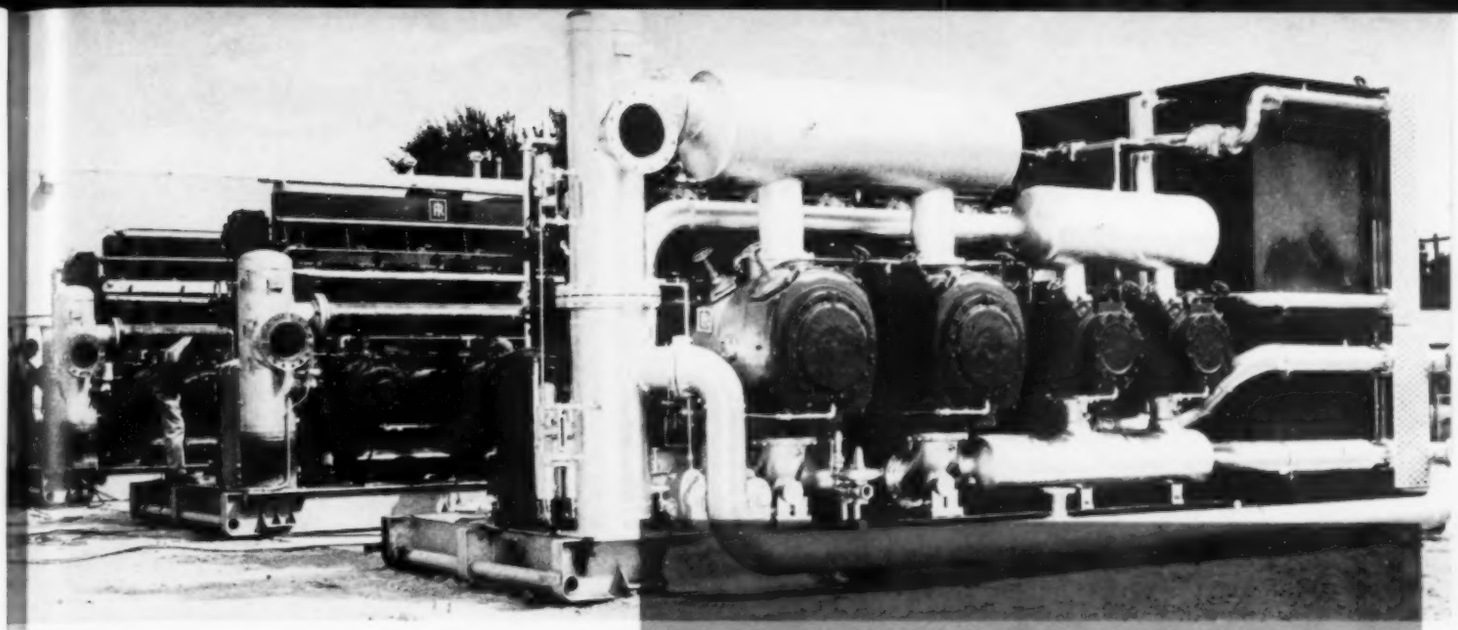
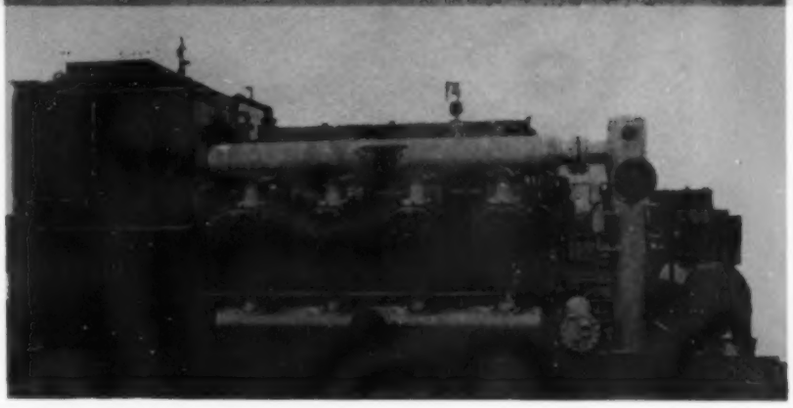
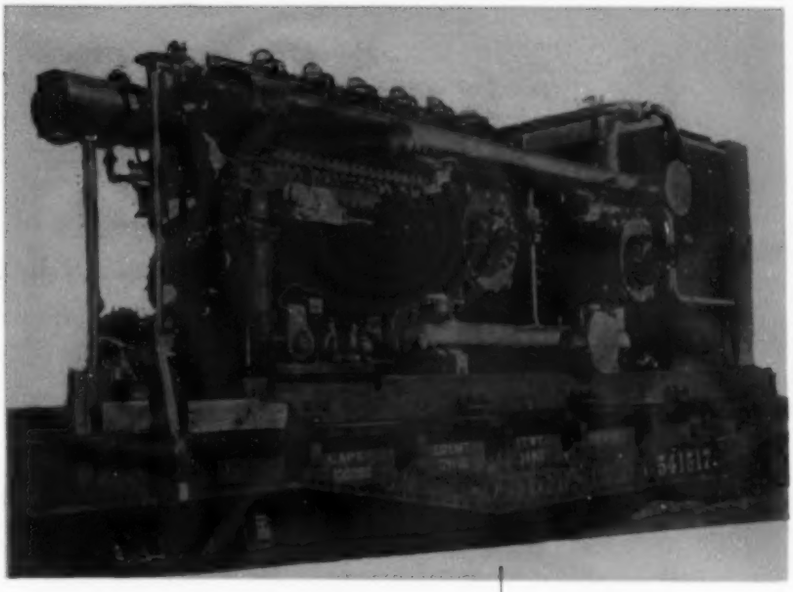


THERE'S MORE FLEXIBILITY IN THESE PACKAGE COMPRESSORS





Stearns-Roger's extensive manufacturing facilities and gas engineering personnel are exclusively responsible for your packaged compressor plant, from quotation to on-site operation. Our complete service assures you of a plant "custom built" to utmost efficiency and economy for the precise conditions of your field.

Each rugged, compact unit, with the compressor of your choice, is completely design-engineered just as are much larger permanent field installations. Stearns-Roger Packaged Compressor Plants provide quick, easy installation and substantially automatic operation. For every important service — process engineering, custom fabrication, field erection...

Ask for our Packaged Compressor Plant Bulletin, covering units from 100 H.P. up.

TAKE IT UP WITH

Stearns-Roger

THE STEARNS-ROGER MFG. CO. · DENVER, COLORADO

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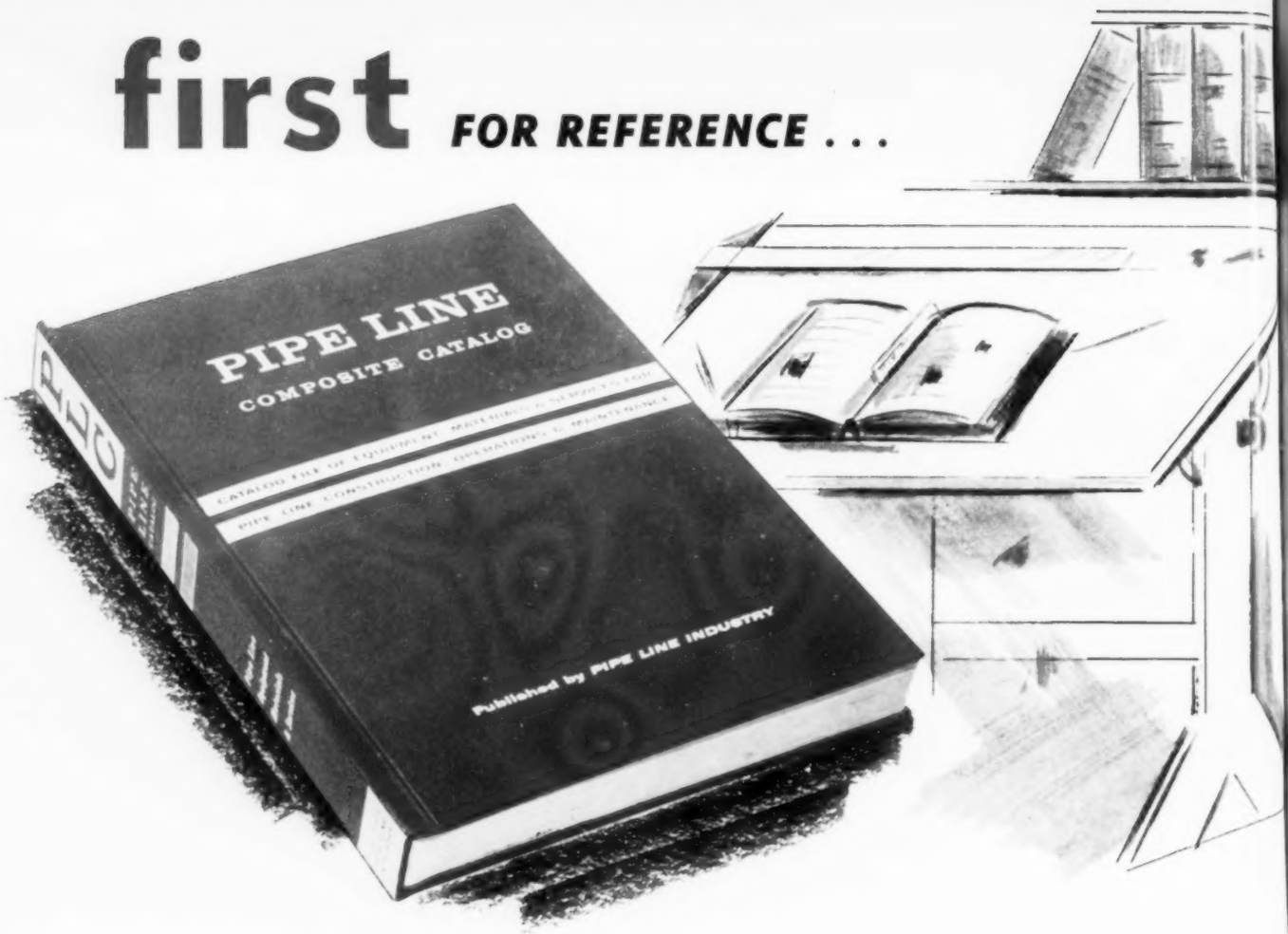

A one-volume reference library for purchasing and specifying. That's the best way to describe the only comprehensive catalog data file published specially for the Pipe Line Industry. Convenient to handle, thoroughly indexed, it is saving time and money for thousands of pipe line men.

first FOR INFORMATION ON MANUFACTURERS AND SERVICE COMPANIES

Included in 147 equipment and service company data in PLCC, there are 1,627 manufacturers' representatives and sources of supply listed.

first FOR INDIVIDUAL EQUIPMENT AND SERVICE ITEMS

There are 11,148 items of equipment and service items cataloged, with detailed information on specifications, installation, operation, maintenance, service—an entire library of useful reference.

first FOR CONSTRUCTION EQUIPMENT AND SERVICE

Pipe Line construction and service items listed in PIPE LINE COMPOSITE CATALOG total 390 . . . an invaluable aid to office and field specifications and purchases.

When you are ready to buy or specify, or if you just want planning information, look first in PIPE LINE COMPOSITE CATALOG.

These leading manufacturers, suppliers and service companies have filed complete or condensed catalog data in the current edition of the new PIPE LINE COMPOSITE CATALOG. See their detailed information in the catalog when you are ready to buy.

ACF Industries, W-K-M Division
The Aerotec Corp.
M. N. Aitken Co.
Alco Products, Inc.
Aldrich Pump Co.
Allied Chemical & Dye Corp., Barrett Division
Allis-Chalmers
Alston Manufacturing Co.
American Blower Division of American-Standard
American Cyanamid Co., Jefferson Chemical Co. Subsidiary
Anchor-Wate
Automatic Power Inc.

Barber-Greene Co.
Barrett Division, Allied Chemical & Dye Corp.
J. B. Beaird Co., Inc.
Berry Hydraulics, Oliver Tyrone Corp.
Bethlehem Supply Co.
Bettis Corp.
Books for Pipe Line Industry
Borg-Warner Corp., Byron Jackson Div.
Bramble Industries, Gulf States Asphalt Co. Division
Bucyrus-Erie Co.
Buffalo-Eclipse Corp., Penberthy Manufacturing Co. Division
G. T. Bynum Co.
Byron Jackson Pumps, Inc., Subsidiary of Borg-Warner Corp.

E. L. Caldwell Co.
Philip Carey Mfg. Co.
Caterpillar Tractor Co.
Cathodic Protection Service
Central Plastics Co.
Clark Bros. Co., One of The Dresser Industries
Coffing Hoist Division, Duff-Norton Co.
Colorado Fuel and Iron Corp., Wickwire Rope Division
Commercial Iron Works
Cook Bros. Equipment Co.
C. Lee Cook Co., Division of Dover Corp.
Corrosion Rectifying Co., Inc.
G. A. Cotten Co.
M. J. Crose Manufacturing Co., Inc.
Crutcher-Rolfs-Cummings, Inc.

Darling Valve & Manufacturing Co.
John Deere—Industrial Division
Dover Corp., C. Lee Cook Co. Division
Dresser Industries, Clark Bros. Co. Division
Magnet Cove Barium Corp. Division
Drive-Thru Gate Co.
Duff-Norton Co., Coffing Hoist Division
Dutch Brand Division, Johns-Manville Corp.

Allan Edwards, Inc.
Elliott Co., Ridgway Division
Embart Manufacturing Co., The Maxim Silencer Co. Subsidiary
Engineering Research Corp.

Falk Corp.
Farrel-Birmingham Co., Inc.
Federal Telephone and Radio Co., Division of International Telephone and Telegraph Corp.
Fish Engineering Corp.
Flexitallic Gasket Co.
Fluor Products Co., Division of Fluor Corp., Ltd.

Gardner-Denver Co.
Gaso Pump & Burner Mfg. Co.
Gearench Mfg. Co.
General Electric Co.
The Gorman-Rupp Co.
Granberg Corp.
Greenhead Sling and Supply Co.
Greenwood Valve Division, Vernon Tool Co., Ltd.
Grove Valve and Regulator Co.
The Gulf Publishing Co. (Pipe Line Forms)
Gulf States Asphalt Co., Division of Bramble Industries

H & L Tooth Co.
H & M Pipe Beveling Machine Co.
Hamer Valves Inc.
Hammond Iron Works
Haynes Manufacturing Co.
Hercules Motors Corp.
Holcombe Co., Inc.
Homelite, Division of Textron Inc.
Houston Equipment Co., Inc., Division of Houston Foundry & Machine Co.
Hudson Engineering Corp.
Humble Oil & Refining Co.
Hydril Co.

Ingersoll-Rand Co.
International Telephone and Telegraph Corp., Federal Telephone and Radio Co. Division

Jefferson Chemical Co., Subsidiary of American Cyanamid Co.
Johns-Manville Corp., Dutch Brand Div.

King Tool Co., Ltd.
Kinzbach Tool Co., Inc.

L & M Company
L-K Pump Valve Co.
Ledeen Mfg. Co.
LeRoi Division, Westinghouse Air Brake Co.
Lloyd Metal Foundry
Lubrikup Co., Inc.
Lufkin Foundry & Machine Co.

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Magnetrol Inc.
S. N. M. A. R. E. P.
Marsh Instrument Co.
Mason-Neilan Division of Worthington Corp.
C. A. Mathey Machine Works, Inc.
Mavor-Kelly Co.
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McFarland Engineering & Pump Co.
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McKissick Products Corp.
Mercoid Corp.
Midwestern Pipe Line Products Co.
Mine Safety Appliances Co.
Mixing Equipment Co., Inc.
Modern Motors Sales & Service
Morris-Young-Owens Co.
Mountain States Asphalt Co., Division of Bramble Industries
Multiple Corp.
Frank W. Murphy, Manufacturer, Inc.

National Cylinder Gas Co., Tube Turns Division
National Tank Co.
Naylor Pipe Co.
Nickles Machine Corp.

Oliver Tyrone Corp., Berry Hydraulics
Oil Well Supply Division, United States Steel Corp.

Panellit, Inc.
Peerless Manufacturing Co.
Pelican Supply Co., Inc.
Penberthy Manufacturing Co., Division of Buffalo-Eclipse Corp.
Perrault Equipment Co.
Petrolite Corp., Tretolite Co. Division
Pipe Line Development Co.
Pipelife Corp.
Pittsburgh-Des Moines Steel Co.
Plyon QX, Modern Motors Sales & Service
Porter Co.
Potter Aeronautical Corp.
Protecto Wrap Co.
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Taylor Instrument Companies
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Yale Machine Works

PIPE LINE COMPOSITE CATALOG

Published by PIPE LINE INDUSTRY

P. O. BOX 2608 **HOUSTON, TEXAS**

Photo courtesy of Oil & Gas Journal

WHY PIPELINERS DEPEND ON GORMAN-RUPP PUMPS

How do you lay a pipeline? You dig the dirt. You blast the rock. You fight the water. And you try to stay on schedule.

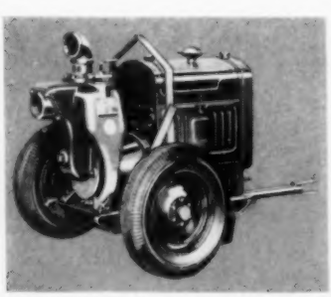
When it rains hard . . . or you hit a bog, that water can lick you. So you depend on Gorman-Rupp Pumps.

Laying pipelines, the pumping jobs come up in a hurry, require fast pumping. You dare not fail—so you call on Gorman-Rupp Pumps. They keep the job moving . . . whether for highways, dams, bridges, buildings . . . or for pipelines.

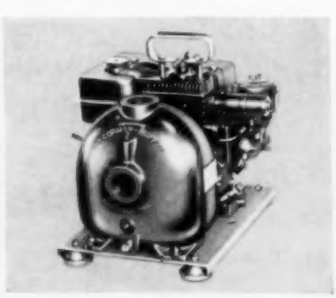
Pipeliners *know* Gorman-Rupp Pumps are "unsurpassed for pumping fast." You are near a Gorman-Rupp Distributor. In emergencies, telephone.

THE GORMAN-RUPP COMPANY

305 Bowman Street • Mansfield, Ohio

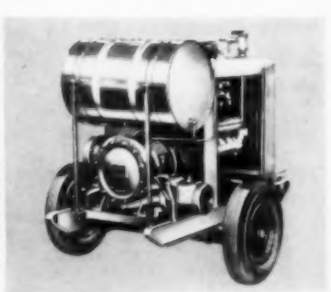


Contractors' Pumps — 3" to 10"

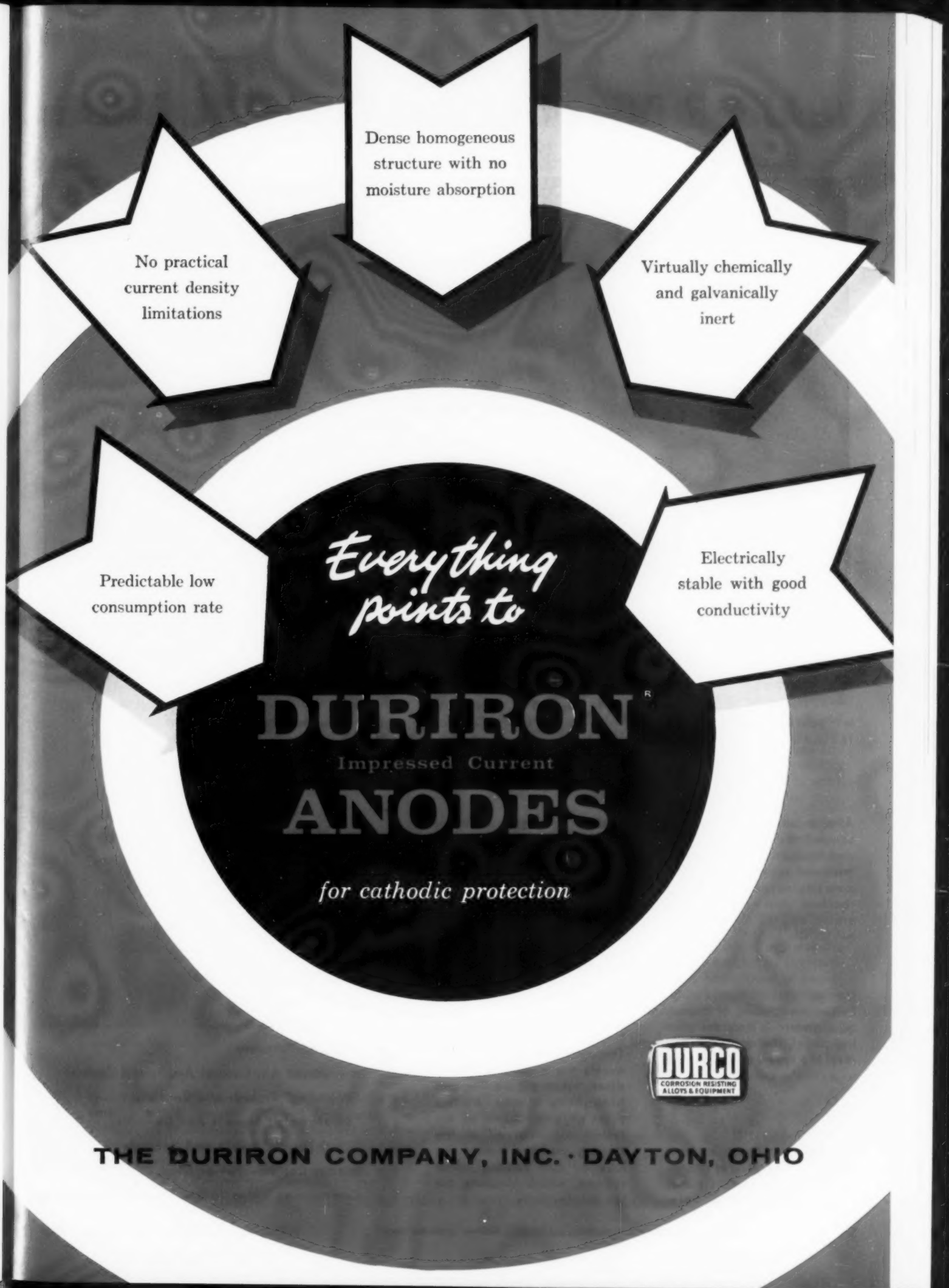


"80" Series Lightweights — 1½" to 3"

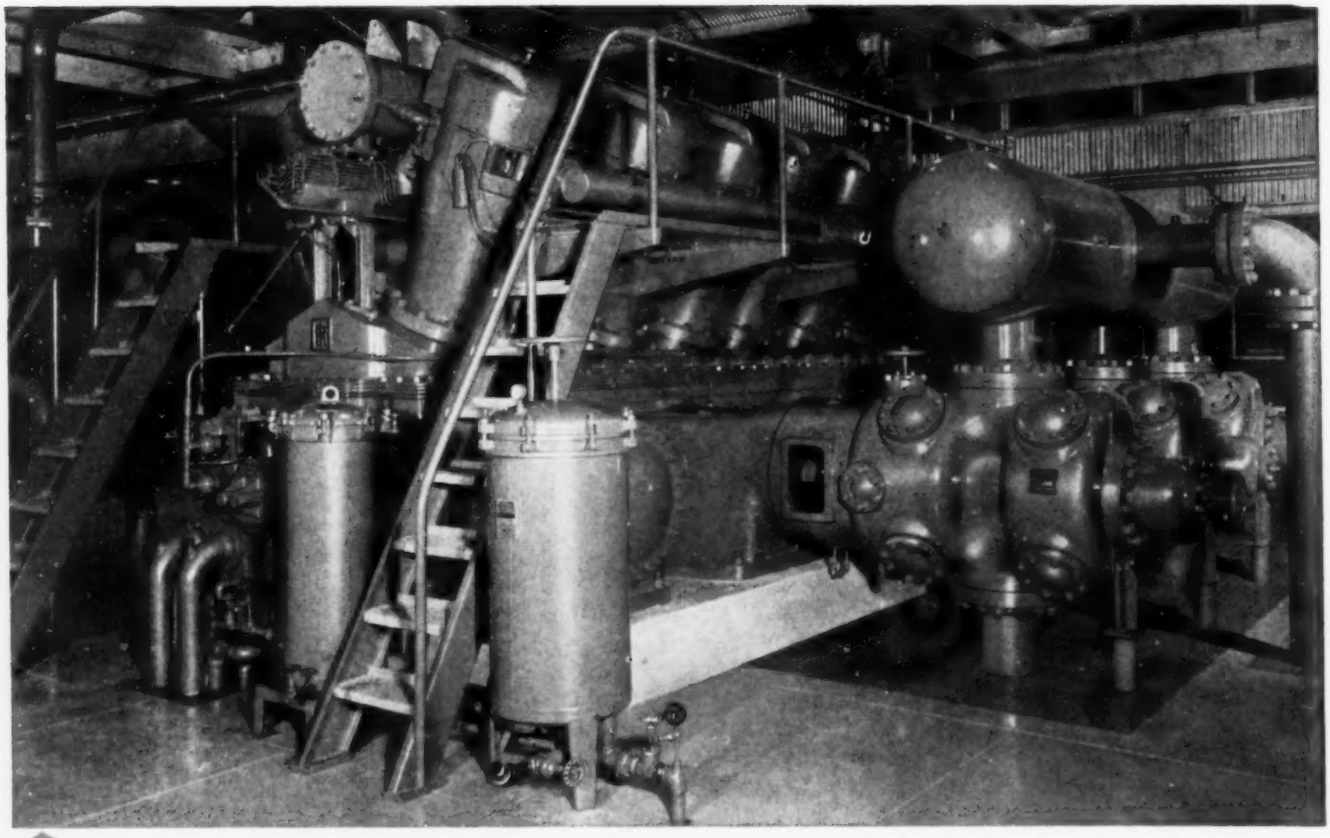
Diaphragm Pumps — 3" and 4"



Jetting Pumps


Dense homogeneous structure with no moisture absorption
No practical current density limitations
Virtually chemically and galvanically inert
Predictable low consumption rate
Electrically stable with good conductivity
Everything points to
DURIRON®
Impressed Current
ANODES
for cathodic protection
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT
THE DURIRON COMPANY, INC. · DAYTON, OHIO

AUTOMATIC CONTROLS



This 1320-hp Ingersoll-Rand KVG gas-engine compressor is in operation at the Hooper Station of Northern Natural Gas Co. The unit is arranged for fully automatic operation as noted below.

CONTROL PHASES PROVIDED

Starting Control

After unloading the compressor end, the engine is started and brought up to a predetermined speed. When minimum engine temperatures are reached, stop valves are operated and the compressor is put on the line.

Normal Speed Control

By remote loading of the engine governor from the control panel, the operator may reset the speed of the engine to meet the demand for gas.

Warning Control

Any abnormal operating temperatures or pressures are reported at the control panel by a signal light and horn.

Emergency Control

Operating temperatures or pressures which reach emergency conditions are reported at the control panel by a light and horn. At the same time the engine is immediately shut down and all components of the system returned to starting position. Lube oil and cooling water circulate for 10 minutes more before being shut off.

Normal Shutdown Control

Through a series of timed events the engine is slowed down, taken off the line and brought to a stop. At this point all components of the system are returned to the starting position except the lube oil and cooling water systems, which circulate for ten minutes more.

Automatic control panel for I-R gas-engine compressor, designed by Viking Instruments, Inc., in cooperation with Ingersoll-Rand engineers. The panel includes the following instrumentation:

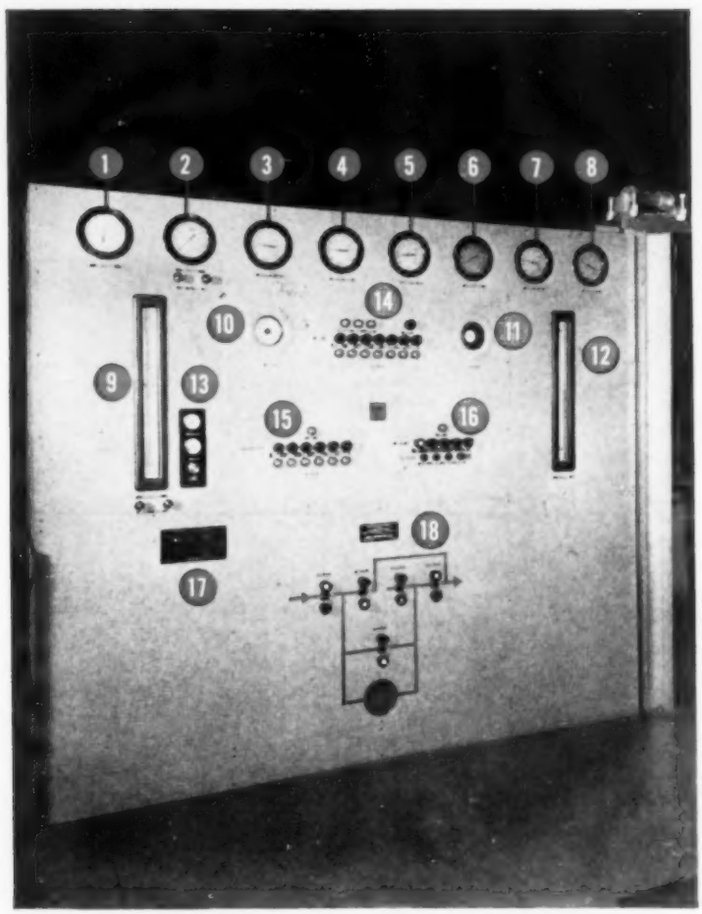
1. Starting Air Pressure
2. Lube Oil Pressure
3. Lube Oil Temperature—entering cooler
4. Lube Oil Temperature—leaving cooler
5. Oil Cooler Water Temperature
6. Jacket Water Pressure
7. Jacket Water Temperature—inlet
8. Jacket Water Temperature—outlet
9. Manifold Depression
10. Tachometer
11. Engine Hours
12. Fuel Gas Pressure
13. Instrument Air, Control Air, Speed Control
14. "Warning" Signals and Controls
15. "Emergency" Signals and Controls
16. "Start-Stop" Signals and Controls
17. Master Control—Power, Stop, Start, Off
18. Compressor Valve Indicators and Controls

For more data on advertised products, use Readers' Service Cards, last page.

make IR gas-engine compressor

"THINK FOR ITSELF"

1320-hp KVG at Hooper Station of Northern Natural Gas Company features Fully-Automatic Sequence Control



A touch of a button activates the system which puts this big gas-engine compressor into action—another touch shuts it down. And all the time it's running, automatic instruments control the operation and protect it against damage from any cause.

This Ingersoll-Rand 4-cycle, V-angle KVG gas-engine compressor is arranged for completely automatic sequence control operation with a Viking instrument panel. The 1320-hp unit is installed at the Hooper (Nebraska) station of Northern Natural Gas Company.

This unit is not only automatic in operation, but is completely self-protecting. Continuous monitoring and alarm facilities permit immediate diagnosis of any trouble at an early stage, so *preventive* rather than *curative* measures can be taken—thus down-time and costly repairs are minimized. Should any operating conditions exceed safe limits, the machine is automatically shut down before any damage can be done.

On normal shutdown, the engine is slowed, taken off the line, idled for a minute at no load, and then brought to a stop. After either normal or emergency shutdown, lubricating oil and cooling water are circulated for ten minutes.

Ingersoll-Rand 4-cycle V-angle engine-compressors are ideal for automated and remote-control installations, due to inherently greater operating *stability* through a wide range of speeds and loads. Ingersoll-Rand has supplied millions of horsepower of heavy-duty compressors for every possible service, and builds many types of other equipment, in addition to compressors, for the pipeline industry. Call your I-R representative now for more information.

Only IR compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of straight-lifting stainless-steel channels and leaf springs, with trapped-air spaces which cushion action, prevent impact.

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ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

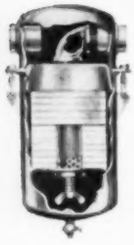
Dollinger makes ALL TYPES of filters as shown on this page, plus special filters for unusual filtration problems. New users of one specific type of Staynew filters often find a second Dollinger filter performs a great, added service in other processes or operations. Dollinger maintains complete engineering, design and laboratory facilities for the development of special filters for new and unusual applications.

Write for complete information on any of the Staynew filters illustrated. Be sure to specify Bulletin Number or Numbers. Consult Dollinger Engineers on any special filtration problems—no obligation. Dollinger Corporation, 95 Centre Park, Rochester 3, N.Y.

PIPE LINE FILTERS

Model CPH
Pipe Line Filter
Bulletin 200

Model CVH (Vacuum)
Pipe Line Filter
Bulletin 200



Model AAPHS
(Absorption)
Pipe Line Filter
Bulletin 200

Model HPH and AHPH
(High Pressure)
Pipe Line Filter
Bulletin 200

LIQUID FILTERS

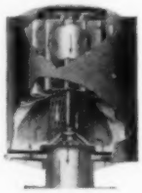
Model HE (Sump)
Liquid Filter
Bulletin 330

Model ELS (Pressure)
Liquid Filter
Bulletin 300

AIR INTAKE FILTERS

Model IDR
(Ground Level)
Air Intake Filter
Bulletin 100

Model DS (Silencer)
Air Intake Filter
Bulletin 100



Model D (Outdoor)
Air Intake Filter
Bulletin 100

Model C (Indoor)
Air Intake Filter
Bulletin 100

VENTILATION FILTERS

Electro-Staynew
Mist Collector
Bulletin 420

Electro-Staynew
Precipitator
Bulletin 400

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Ventilation Filter
Bulletin 500

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Viscous Panel
Ventilation Filters
Bulletin 600 and 700

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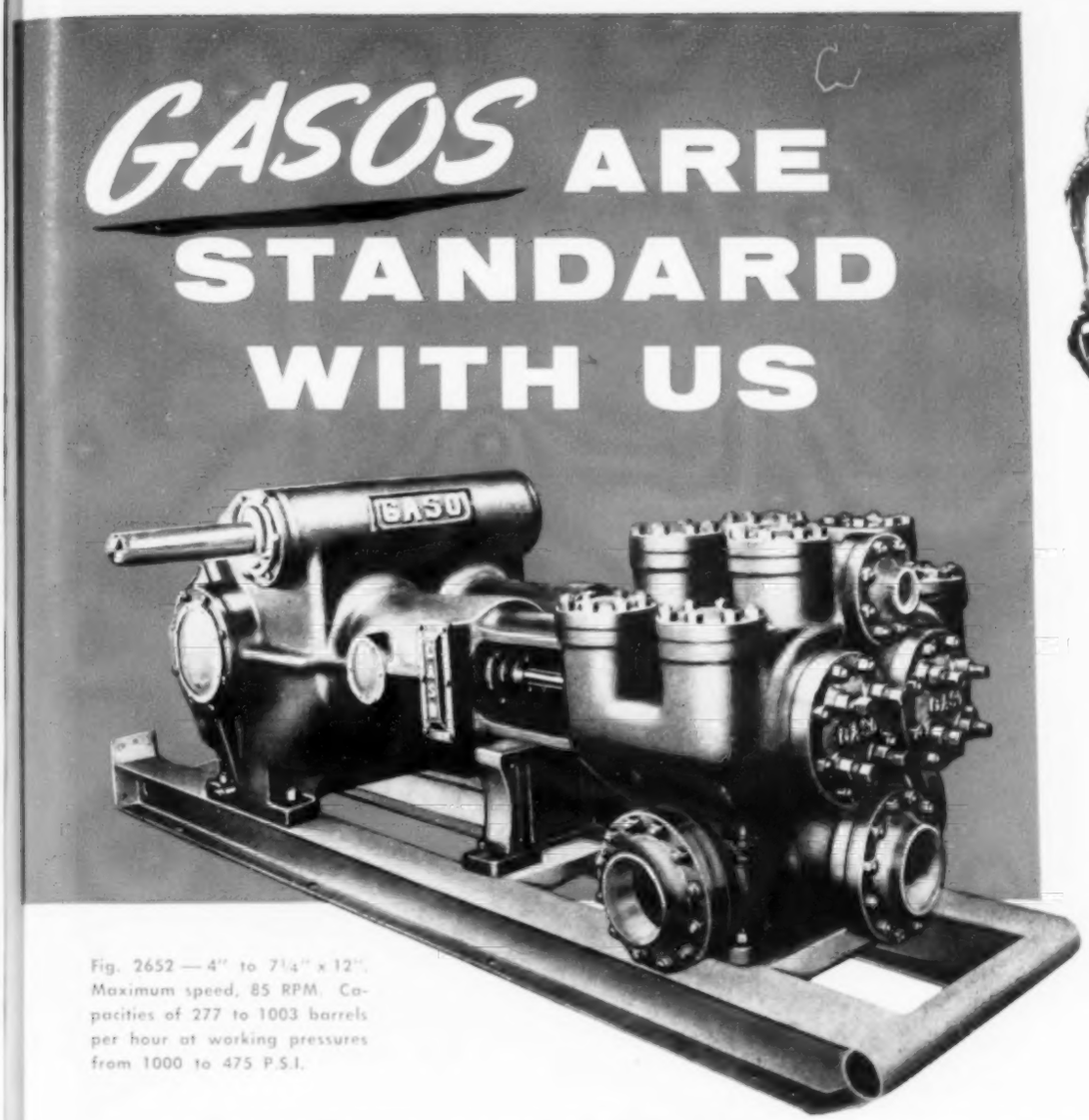

Fig. 2652 — 4" to 7¼" x 12". Maximum speed, 85 RPM. Capacities of 277 to 1003 barrels per hour at working pressures from 1000 to 475 P.S.I.

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As engineers, the men in my department deal in facts. They know from experience that Gaso offers models exactly suited to our various needs. They know from our service records that Gaso Pumps consistently deliver top service for unbelievably long periods, with remarkable low maintenance and upkeep costs. And they know from personal contact that they can rely on Gaso distributors for on-the-spot information, recommendations and parts service. Add up the advantages and you'll understand why we, as engineers, took the guesswork out of pump buying by making the specification of GASOS a company policy.

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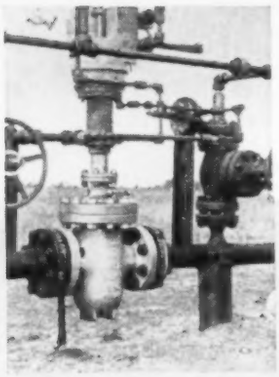
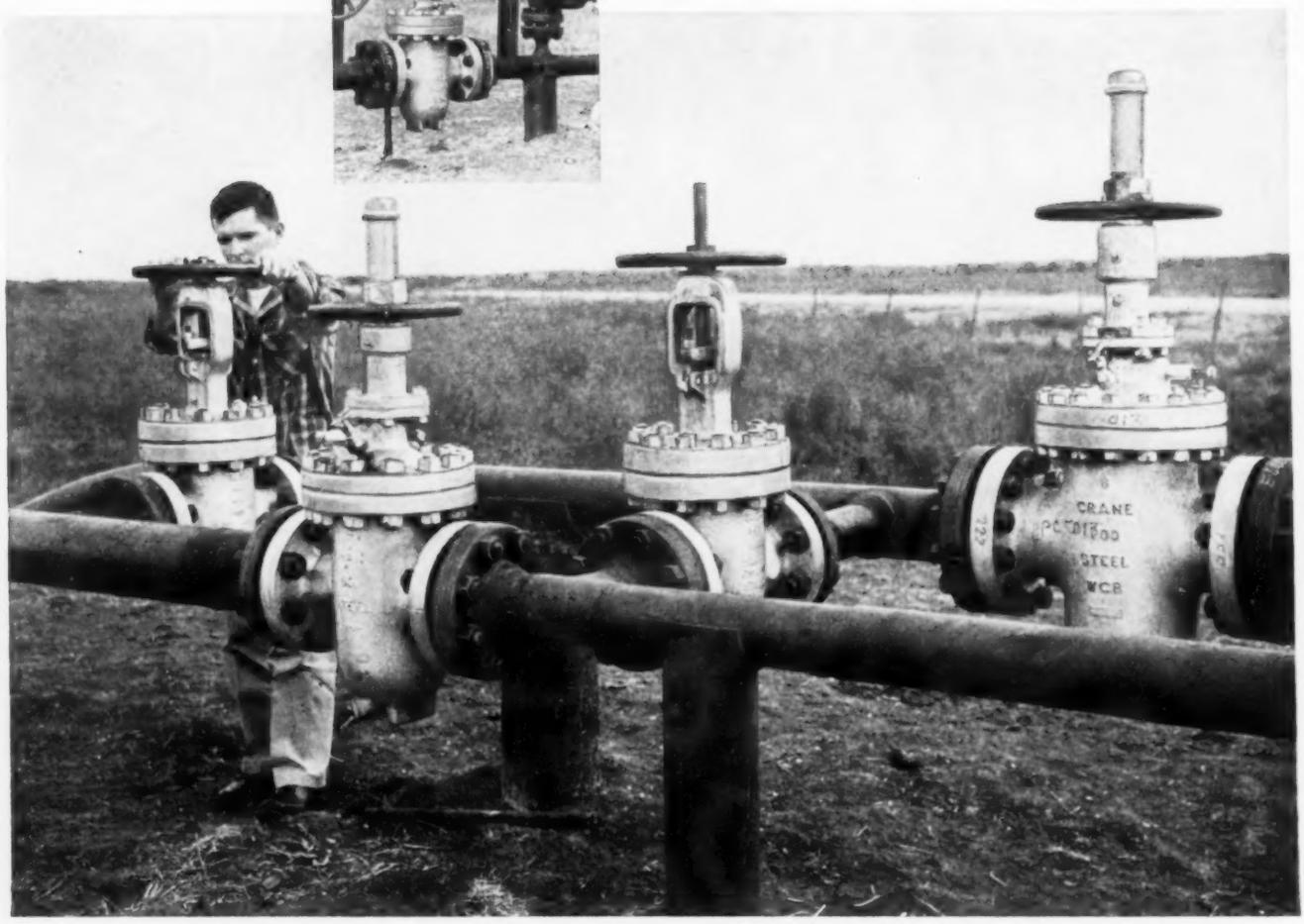


Left—Crane conduit-type valve with automatic operator at one of six stations.

Below—4- and 6-inch Crane conduit-type valves at scraper trap setting in 70-mile ethylene line.



Ethylene Handled by Crane Conduit Valves in Phillips Chemical's 70-Mile Line

Phillips Chemical Company's ethylene pipeline from the Sweeny refinery to its Pasadena, Texas, plant crosses some 70 miles of rough, jungle-like country.

Valving for the line had to be specially designed to protect against product loss, and to insure safety.

All the line valves are new-type Crane conduit gates, Class 600 and Class 900. At six locations they are equipped with automatic operators. Should line leakage cause a pressure drop of 30 to 40 pounds, these valves will close automatically in 22 seconds. Other conduit valves are installed in the scraper trap settings.

Since they were installed a year and a half ago, these valves have operated without trouble of any kind. They close tightly and easily, and require no maintenance or periodic lubrication.

Both the *new* Crane conduit valves and the companion line of Crane double-disc pipeline valves are described in Crane Catalog AD-2198. A request to the address below or a call to your local Crane outlet will bring a copy quickly.

ASK FOR CATALOG AD-2198—Completely covers the new companion lines of Crane conduit-type and double-disc pipeline valves.

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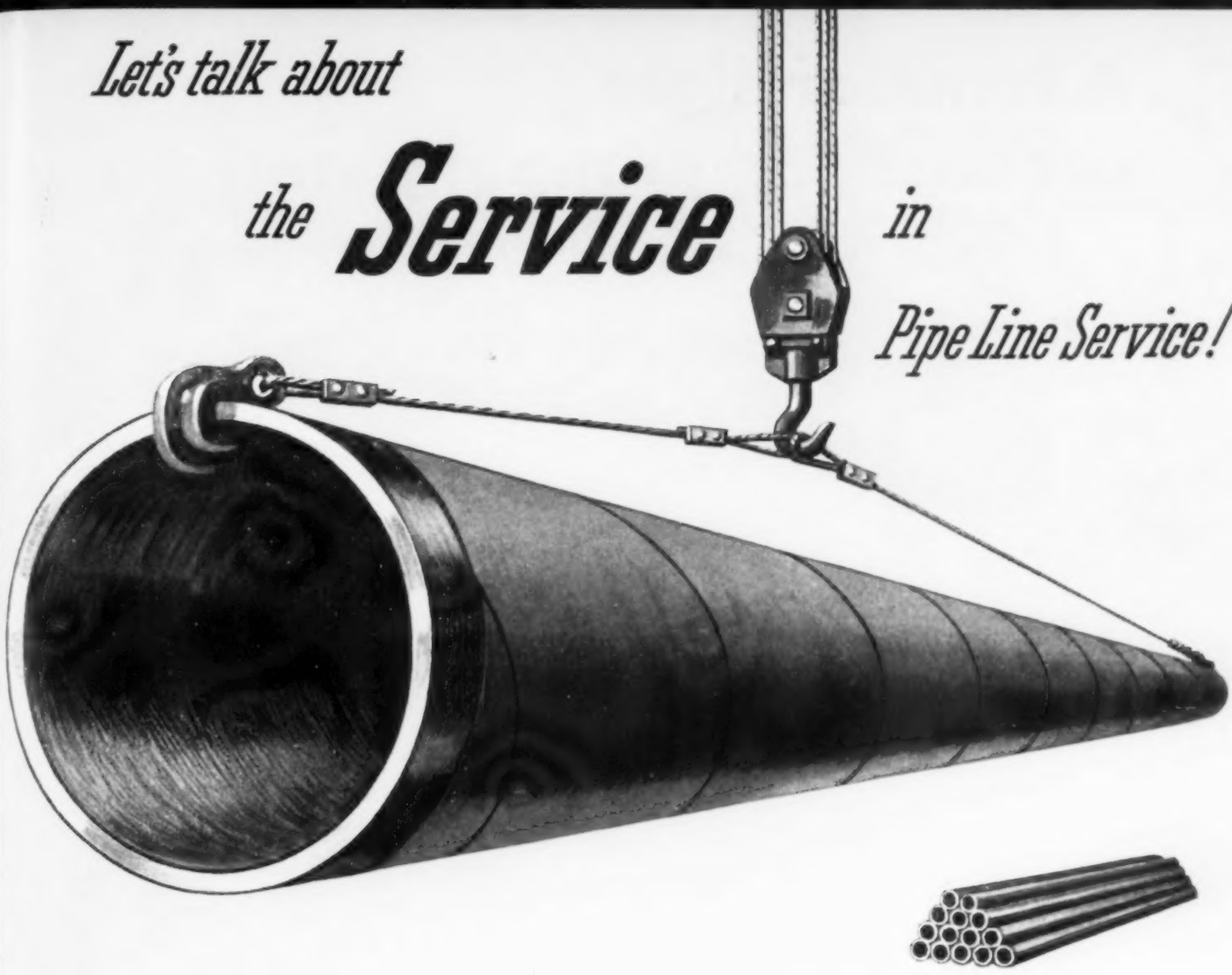


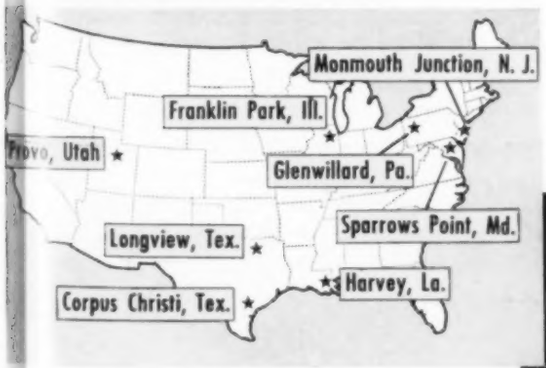
A company doesn't become a leader through quality of product alone. Although Pipe Line Service through the years has proved consistently that quality depends on coating and wrapping under controlled plant conditions, *service* is half the battle.

By service, we mean storing your pipe *at no cost to you* . . . plants strategically located near your sources of supply . . . and large storage facilities to allow you to purchase pipe when delivery is most favorable. Your pipe will be held in storage until needed—and then coated under the PLS high standards of uniformity. You *always* get a freshly applied coating job at the time pipe is ready to be laid. And PLS will ship your protected pipe *where* you want it . . . *when* you want it!

All this, *plus* the service of a PLS representative when needed. It's his job to help you in the proper handling, storage and laying of PLS protected pipe, to give you the maximum return on your investment.

This combination of quality *and* service assures you of the finest in pipe protection. On your next coating job call in your nearest PLS representative—you'll find that he can save you time, trouble and money.

There's a PLS plant strategically located to serve YOU!



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Pipe Line Service Corporation

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A familiar sight around gas pumping stations

One of six new semi-automatic gathering stations of the Northern Natural Gas Company that have Midwest "Long Tangent" Elbows ... and other Midwest Welding Fittings.

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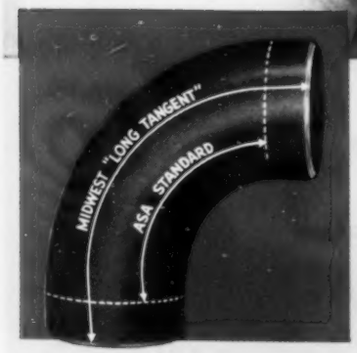
Midwest "Long Tangent" Welding Elbows are "a natural"... their many benefits for the user are today so generally recognized that you see them wherever you go. For all the facts, ask your Midwest Welding Fittings Distributor (or write us) for a copy of Catalog 54.



ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- They save pipe.
- They often eliminate short nipples and their extra welds.
- They save time and money in lining up and clamping pipe and fitting.
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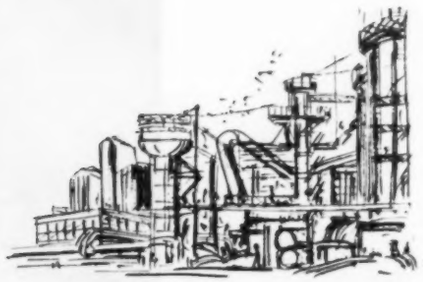
the fittings CTF *have this stamp*



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OPTIONAL: 7-foot angle dozer; rearend winch; 8 forward and 2 reverse speed transmission; trailer hitch; 3-pin connected, boom mounted bending shoe (available in 2, 4, 6 and 8" sizes).

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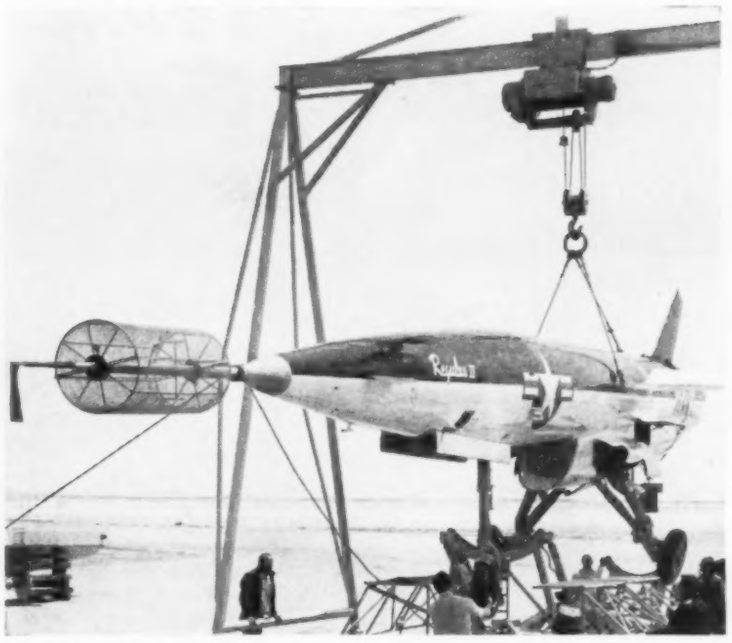
How Tuffy Slings move mighty Regulus Missiles



Regulus II gets a lift with Tuffy Slings. This long-range supersonic jet-powered missile is designed for launching from submarines, aircraft carriers, cruisers and shore bases. Test and training versions are equipped with landing gear so they may be recovered after each flight saving taxpayers millions of dollars.

America's intercontinental ballistic missile is still in the future, but the U. S. Navy has intercontinental assault capability today in the combination of submarine and the Regulus I and II guided missiles.

The Chance Vought Regulus I is a fully operational missile that can deliver an atomic warhead more than 500 miles, anywhere in the world. The Regulus II, soon to be operational, has already flown at supersonic speeds and altitudes of more than 50,000 feet.

As the pictures here show, Tuffy Slings are entrusted with the handling of these mighty missiles. Tuffy Slings are used all along the line of production and delivery.

The same combination of strength and flexibility that made Tuffy Slings the choice for this momentous job is yours in Tuffy Slings for every sling use. You get the same machine-braided fabric that resists kinking and from which kinks that do occur are easily removed without material damage. You get the same Tuffy pressed-on ferrule that gives the eye-splice 100% the strength of the fabric. For longer sling life, greater efficiency and safety, get in touch with your Tuffy distributor.

Tuffy helps "can" a missile: Regulus I is shown here being loaded into shipping can with Tuffy Slings. The weight of the missile is classified, but we can say that the weight of the shipping can lid, shown in lower picture, is 3,500 lbs.

Lowering Regulus I onto a submarine, Tuffy Slings are again part of the picture. The fact that such a valuable and vital weapon is entrusted to Tuffy Slings is one of the finest testimonials to Tuffy quality, dependability and safety.

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FREE TUFFY SLING HANDBOOK
Full sling data and specifications plus complete rigger's handbook.

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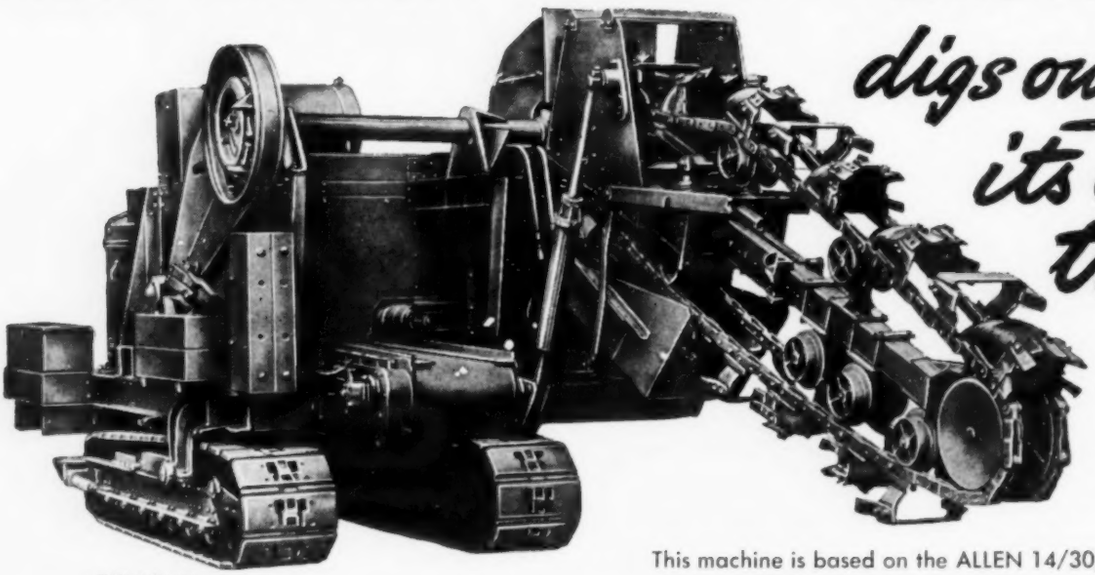
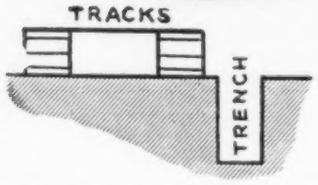
The ALLEN *OFFSET* TRENCHER



digs outside its own tracks



This diagram shows the position of the trench in relation to the tracks. The middle of the trench is 49 inches from the centre line of the machine.

This machine is based on the ALLEN 14/30, but the digging boom is offset to the right. With this arrangement trenches can be dug very close to obstructions, and in positions where no other trencher could be used.

With a side mounted boom there is considerable lateral stress when working. To withstand this the frame is constructed of massive steel channels, and the drive shaft mounted in a heavy tubular support. Trench widths range from 12-in. to 21-in. Maximum digging depth is 4-ft. 6-in.

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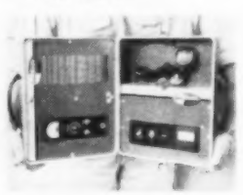

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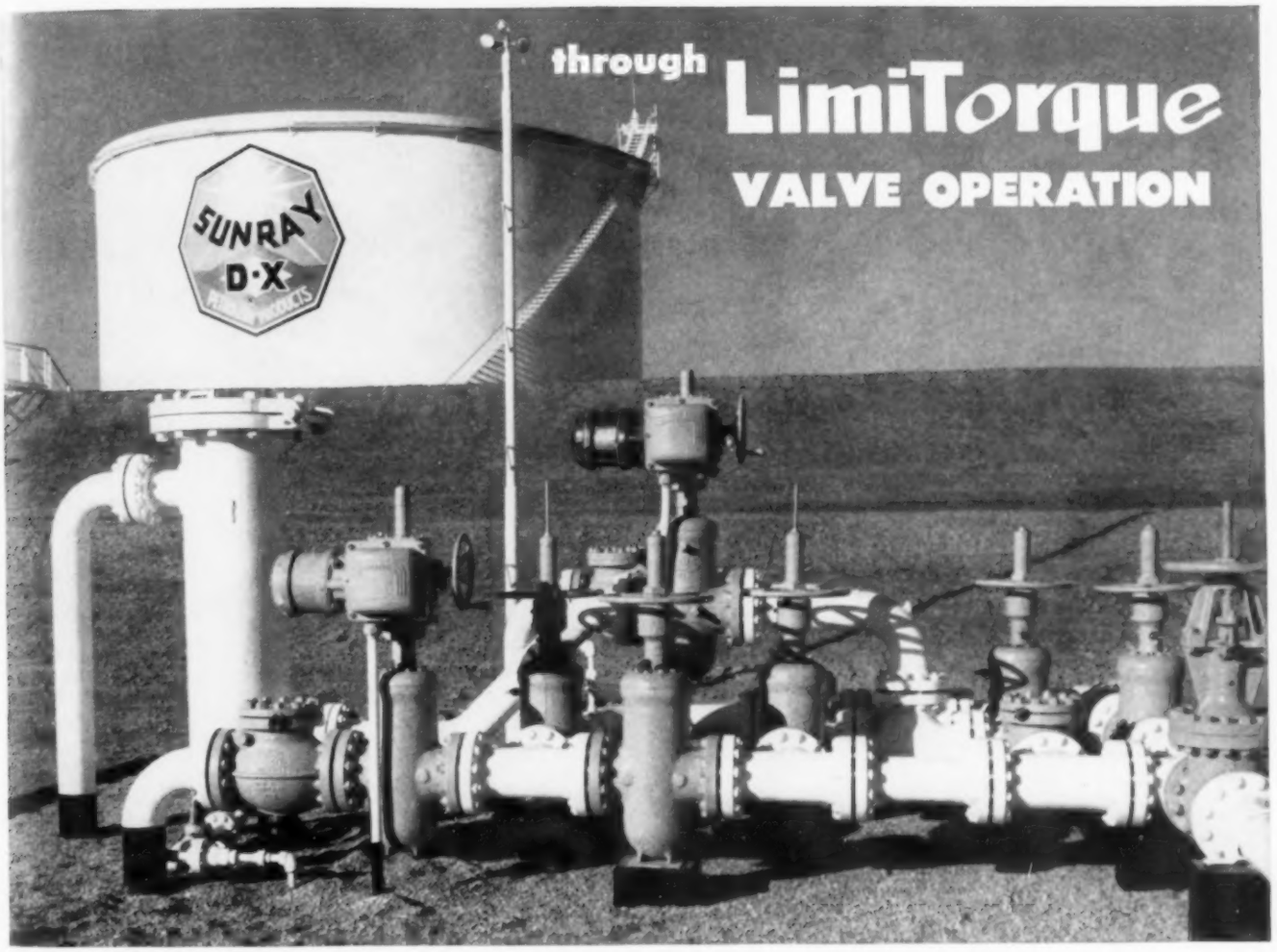

...at D-X Sunray Pipeline Co., Garvin County, Okla.

As in many other high pressure gas and oil transmission lines and refineries throughout the World, LimiTorque is here automatically opening and closing valves from a conveniently located control point—eliminating guesswork and reducing labor costs. One man can operate any type of valve quickly and dependably in remote, inaccessible or hazardous locations; thus vital pipeline and refinery operating procedure can be handled easily by key personnel, safely and economically . . . Also, LimiTorque eliminates any possible damage to vital valve parts in closing, due to its unique torque limiting mechanism. LimiTorque may be actuated by any available power source, such as Electricity, Oil, Gas, Air or Water; and is available for Micro-wave control. LimiTorque controls can be field-mounted on existing valves —contact your valve manufacturer, or nearest sales-engineering office.

Send for Catalog L-550; and please use your Business Letterhead when requesting a copy.

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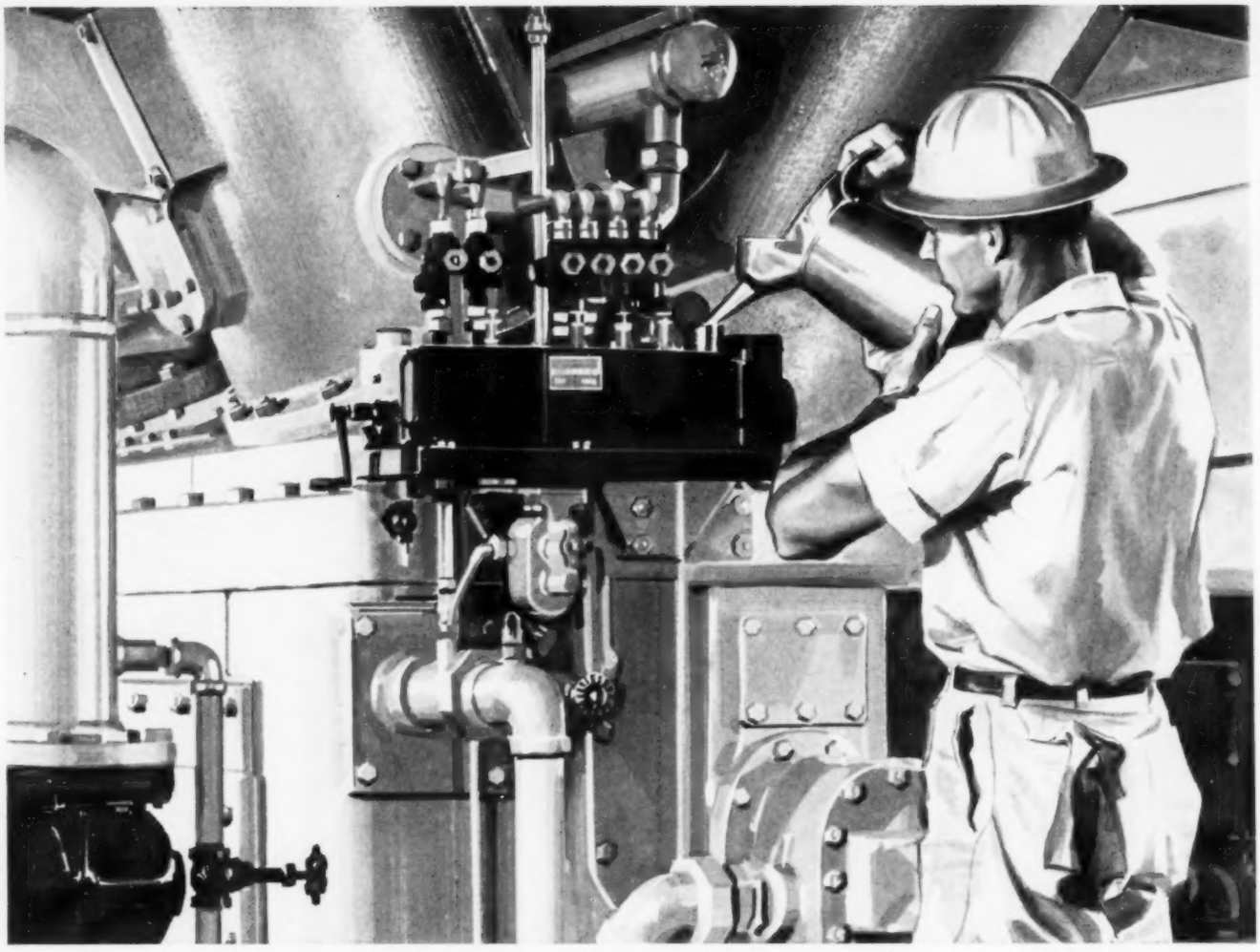

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Using the same GM 6-71 diesel engine, a Jaeger "600" delivers the same air volume at 1650 rpm that all other rotaries need 1800 rpm to produce.

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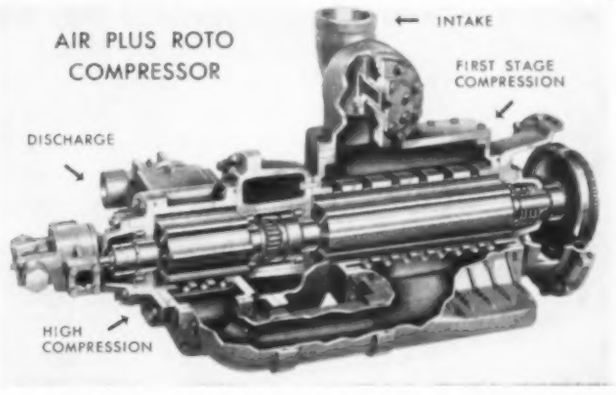
Similar high efficiency at low speed (1700 rpm full load speed compared with 1800 to 2150) is characteristic of Jaeger 125, 250 and 365 models. Check with any Jaeger user—or ask your Jaeger distributor for complete information that will help you cut your air costs on coming work.



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PIPE LINE PANORAMA

Tapline Turbines Set Industry "Firsts" . . . To boost capacity on 754-mile, 30-31 inch line from Saudi Arabia to Lebanon, Tapline has added six gas turbine pumping units (See next page). Capacity increase: From 320,000 to 450,000 bpd.

New units are of two types: Portable prefabricated units for unattended operations—permanent units at manned stations. Portable units mark several industry advances:

- First time oil-fueled gas combustion turbines have been remotely controlled in main line crude service.
- First time a main line oil pump has been driven directly at gas turbine speeds (5,000-6,000 rpm).
- First time a complete 5,000-horsepower pumping unit has been prefabricated and made entirely portable.

A.C.T. Installations Triple in Four Years . . . Recent survey shows 18 producing and 29 pipe line companies will have approximately 99 automatic custody transfer installations in operation by July—three times the number operating in '54. About half will be unattended. Total throughput: 170,000 bpd. Capacity range: 5 to 30,000 bpd, with largest number in 500-1,000 bpd range. (See page 52).

Look for More Pipe Lines to Carry Solids . . . Success of American Gilsonite Company's 6-inch, 72-mile gilsonite pipe line shows excellent potential for further use of pipe lines in transporting different kinds of solids (See Page 61). To date, 170,000 tons (700 tons per day) of gilsonite have been handled by the line at relatively low cost of 2.5 cents per ton-mile.

Actual operation shows volumetric efficiency of 95 percent with solids concentration of 32.5 percent, line regularly handles 40 percent concentration slurry with no efficiency loss. Friction factor is about the same as water—attrition is negligible and slurry is easily filterable with 100 percent recovery.

Needed: More Natural Gas Pipe Lines . . . Winter's severe cold wave put tremendous strain on natural gas pipe line facilities in several parts of the country. Many areas ran out of fuel, or nearly so, forcing industries to shut or slow down operations. Result: Several natural gas companies are planning to expand pipe line operations, i.e., Southern Natural Gas Company has announced $65 million pipe line expansion program, Midwestern and Tennessee Gas are awaiting FPC approval to build $45 million, 350-mile natural gas line from Portland, Tenn., to fuel-hungry Chicago-Gary area.

Examples of big boost in winter natural gas demand: At start of November, industry's volume for previous 12 months was up only 2.2 percent over year before. November sales were 15.5 percent over previous year. December was up 8.8 percent. January, 5.5 percent.

Washington Panorama . . . Pipe line companies have won important decision in Elkins Act debate; in test case, U. S. District Court rejected government charge that Arapahoe Pipe Line paid owner companies (Pure and Sinclair Pipeline) $875,000 too much annually in dividends, stating that payments were within requirements of 1941 consent decree—**Twenty-two governors have joined independent oil operators** in big move to slap mandatory controls on oil imports; rumors are that new trade bill will be forthcoming by late April—Impact of Memphis Decision on pipe line companies is pointed up in comparative investment figures: Natural gas pipe lines invested $616 million for expansion last year, will probably drop to $550 million in '58.

A SPECIAL

PIPE LINE FEATURE

View of completed auxiliary pumping unit on Tapline vividly shows the simplicity, portability, and compactness of station design. Control van unit on the left and the turbine van can be moved quickly for maintenance. A replacement can be installed quickly with a minimum of downtime and cost.

Tapline Boosts Capacity with Turbines

Pumps are direct-driven by 5,000-horsepower, oil-fueled gas turbines. Design of the unattended, remotely controlled stations makes them virtually "portable" for maintenance and operating flexibility.

By W. E. Locher and A. E. Olson
Trans-Arabian Pipe Line Company
Beirut, Lebanon

P. P. Nibley, Trans-Arabian Pipe Line Company, New York

INITIAL OPERATING tests are underway on Trans-Arabian Pipe Line Company's new remotely controlled turbine pumping units. Six 5,000-horsepower, oil-fueled units will provide the additional pumping horsepower in Tapline's project to increase daily throughput to 450,000 barrels.

Placed on the line with original diesel engine-driven pumping equipment, they will boost crude oil delivery through Tapline's 754-mile, 30- and 31-inch pipe line from Qaisumah, Saudi Arabia, to a tanker-loading terminal on the Mediterranean coast near Sidon, Lebanon. Initial line capacity with four diesel stations spaced about 160 miles apart was 320,000 barrels per day.

Gas turbine pumping units are of two types: portable prefabricated units for unattended operation at intermediate sites, and permanently installed units at existing stations. There are unusual features in both. Portable or "auxiliary pumping units" are unique in design. They include a number of innovations in the pipe line application of gas turbines.

It is the first time that a main line oil pump has been driven directly at gas turbine speeds. Their speed range of 5,000 to 6,000 rpm is considerably higher than that commonly used for oil pumps. It is also the first time that a complete 5,000-horsepower pumping unit has been prefabricated and made wholly portable. Unattended and remotely controlled operation of a gas turbine pumping unit also marks another industry first.

System Expansion. Tapline's present system consists of the original line facilities plus:

- Three portable auxiliary pumping units in Saudi Arabia
- A permanently mounted turbine unit at an existing maintenance base in Jordan
- Two permanently mounted turbine units replace original diesel-driven pumping units at the Turaif pump station and increase the horsepower of this station
- Diesel units of the original Turaif plant are being relocated at the other diesel stations of the original system.

In addition, Arabian American Oil Company has installed two similar auxiliary pumping units on its 270-mile line feeding crude oil production into the Tapline system at Qaisumah (see map). One identical unit is available as a standby for the five portable operating units.

Total investment by both companies for these new facilities is about $21 million. This figure includes additional tanks, shops, communications

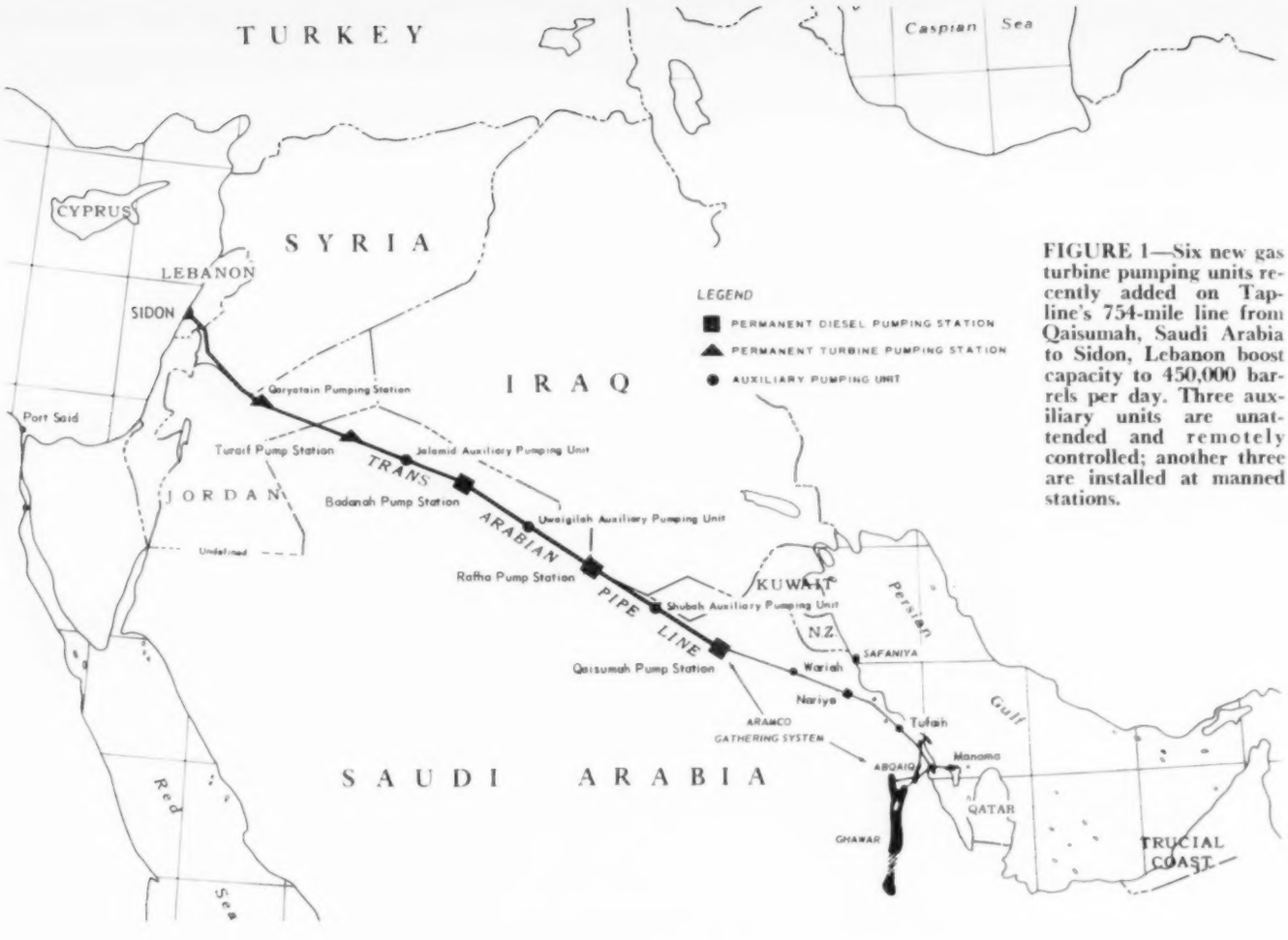

FIGURE 1—Six new gas turbine pumping units recently added on Tapline's 754-mile line from Qaisumah, Saudi Arabia to Sidon, Lebanon boost capacity to 450,000 barrels per day. Three auxiliary units are unattended and remotely controlled; another three are installed at manned stations.

and control systems, and other supporting facilities.

Design Factors Considered. Original main line stations on Tapline are a complete community in the vast and barren Arabian desert. Climate is characterized by extremely low rainfall and by temperatures that reach 120° F. in summer and then drop to 30° F. in winter. Each installation includes housing for 80 to 250 employes, a community center with a dining hall, commissary, recreational facilities, warehouses, garage, shops and a hospital in addition to the main pumphouse and oil-handling facilities. A complete utility system and water supply are also necessary at each station. Water is available only from wells, some of which are more than 1,000 feet deep.

Tapline was initially constructed to accommodate four additional pump stations at intermediate locations. However, the large investment and relatively high operating costs of complete community stations made this type economically unattractive for intermediate sites. The question of what kind of intermediate unit to install was kept under continuous study as development of new equipment made various alternatives available for consideration.

Unattended Turbines Selected. The most attractive way to increase capacity involved installing one 5,000-hp unattended pumping unit at each intermediate location. This installation would consist of only the minimum facilities necessary for pumping oil.

A simple-cycle combustion gas turbine was the only prime mover which satisfied all of the unique design requirements to make these auxiliary pumping units attractive. It met these requirements:

- 5,000-hp output for continuous operation at 110° F. ambient temperature and 2,600-foot elevation.
- Prime mover fueled with crude oil taken directly from the pipe line.
- Unit suitable for unattended operation with supervisory control from base stations 50 to 100 miles away.
- Unit portable enough to permit rotation and major overhauls at a central shop.

Auxiliary pumping units were completely prefabricated and factory-tested in the United States. They were then shipped to Saudi Arabia, hauled overland to the job site, slid onto concrete foundations, and connected to pump oil. Virtually all the work of installation was completed by March 1, 1958.

New Hydraulic Gradient. A simplified profile and hydraulic gradient of Tapline is shown in Figure 2. The solid line shows the hydraulic gradient without the auxiliary gas turbine units. Under this condition the line operates as an open system with a tank connected to the incoming line at each main station. Tanks isolate the sections of the line between main stations, in a hydraulic sense, so that in effect there are four pipe lines, each terminating in a tank. Intermediate gas-turbine-driven pumps are therefore easily brought on stream, since each one affects only the pressures in one section.

The Turaif-Qaryatain-Sidon section

is slightly more complicated because incoming pressure at Sidon is controlled to keep the pipe line packed as its elevation drops sharply from the control point to Sidon. When the gas turbine unit at Qaryatain is started, Sidon must lower its incoming pressure to avoid overpressuring the pipe line between Qaryatain and Sidon.

Pressure Surges Controlled. Addition of gas turbine pumping units, has created a pressure surge problem that did not exist previously on Tapline. In the original system, a 96,000-barrel floating roof tank connected to the suction of each of the pump stations provided protection against dangerous surges whenever a station shut down.

Gas turbine pumping units were added without any provision for tankage at the intermediate locations. It was recognized that, when one of these units tripped off, a high-pressure surge would travel upstream toward the main station. In certain critical regions this would exceed the allowable pipe line pressures. To minimize the effect of surges, Tapline installed surge-protection equipment to permit both the pump stations and the auxiliary pumping units to operate at maximum discharge pressures.

A study of the theory of transient pressures and preliminary tests led to a prediction of pressure distribution curves of the type illustrated in Figure 3. It also shows critical sections where allowable pressure is limited by a change in wall thickness on the pipe line.

Lines marked 33 sec, 56 sec, etc., show the probable progress of an uncontrolled pressure surge travelling in the upstream direction as a result of tripping off the gas turbine unit. It is seen that all three of the critical sections *A*, *B*, and *C*, would be overpressured by the surge.

Shutdown Signal Reduces Pressure Automatically. Critical sections illustrated by *B* and *C* of Figure 3 occur downstream of all four main pumping stations on Tapline. These can be protected by quickly reducing the main station pressure. Under normal conditions, a signal is transmitted over the very-high-frequency communications system as long as the gas turbine unit is running. If the gas turbine unit trips, the signal ceases and the main station pressure is reduced automatically by de-energizing a circuit at that station which reduces its discharge pressure.

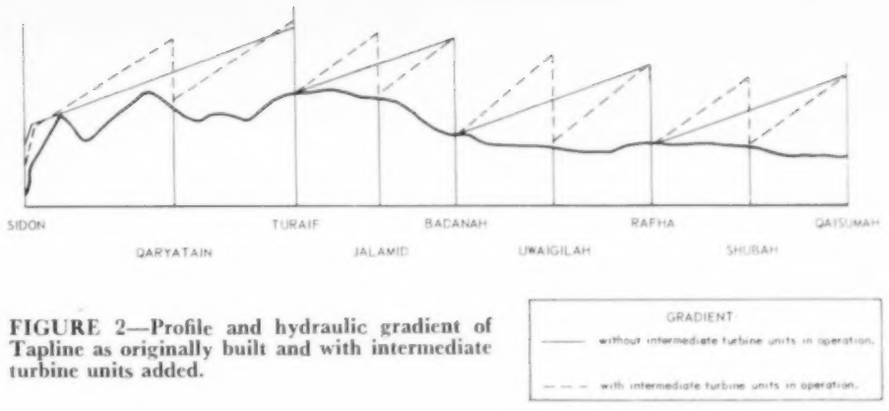

FIGURE 2—Profile and hydraulic gradient of Tapline as originally built and with intermediate turbine units added.

Pressure Relief System. A relief valve is installed at Qaryatain to protect a section illustrated by *A* in Figure 3. This valve is a 10-inch diaphragm-operated type and opens to relieve through a fixed group of four 3-inch friction tubes and thence into a 5,000-barrel tank as shown in Figure 4.

Valve controls are arranged to operate in the following manner:

- Air pressure from a supply tank is applied directly to the valve diaphragm when the gas turbine unit trips off. This pressure opens the valve rapidly.
- After the valve is opened, air is bled off the diaphragm at a controlled rate to close the valve in about six to seven minutes. This allows time for the automatic reduction of discharge pressure at Turaif and the establishment of steady pressure conditions in the pipe line.

This surge protection system has been tested in the Turaif-Qaryatain section. The relief valve and the reduction of Turaif discharge pressure functioned automatically in the manner described above. After the Qaryatain gas turbine unit tripped off, the maximum surge pressures remained safely below the maximum allowable pressures throughout this section of the pipe line. This test confirmed that the design basis for the surge protective equipment was substantially correct.

Auxiliary Pumping Units. Figure 5 shows an aerial view of a typical unattended auxiliary pumping unit. The installation consists of four portable vans: a turbine-pump van, control and filter van, radio van (with 200-foot-high antenna tower permanently erected close-by), and a portable shop van.

A comparison of the extensive facilities at a typical diesel station with the minimum facilities at an auxiliary pumping unit presents a vivid contrast. Yet the hydraulic horsepower delivered to the pipe line by both installations is of the same magnitude.

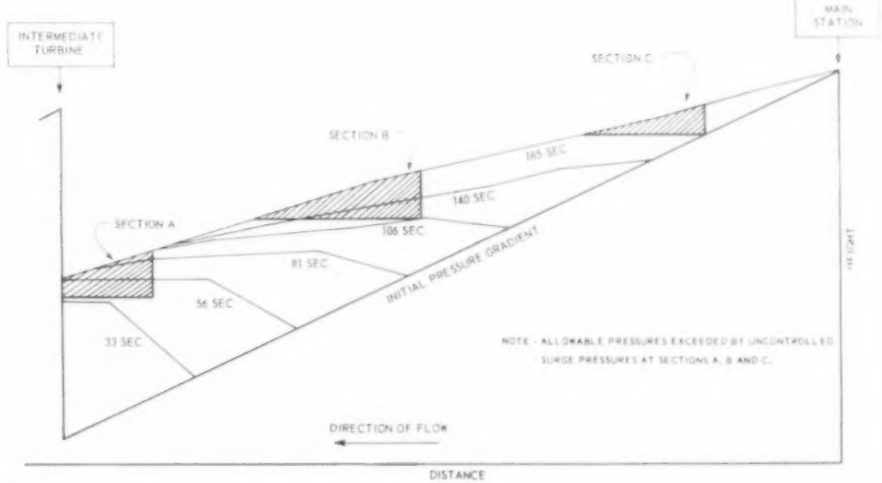

FIGURE 3—Predicted pressure distribution of uncontrolled surges between main stations and intermediate turbine units when turbine trips off. Without control correction excessive line pressures are created at sections A, B, and C.

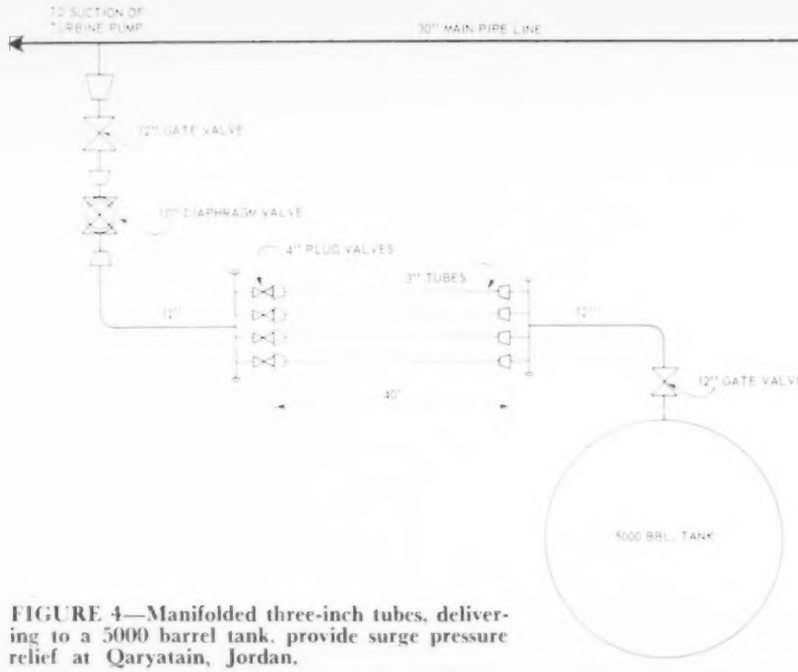

FIGURE 4—Manifolded three-inch tubes, delivering to a 5000 barrel tank, provide surge pressure relief at Qaryatain, Jordan.

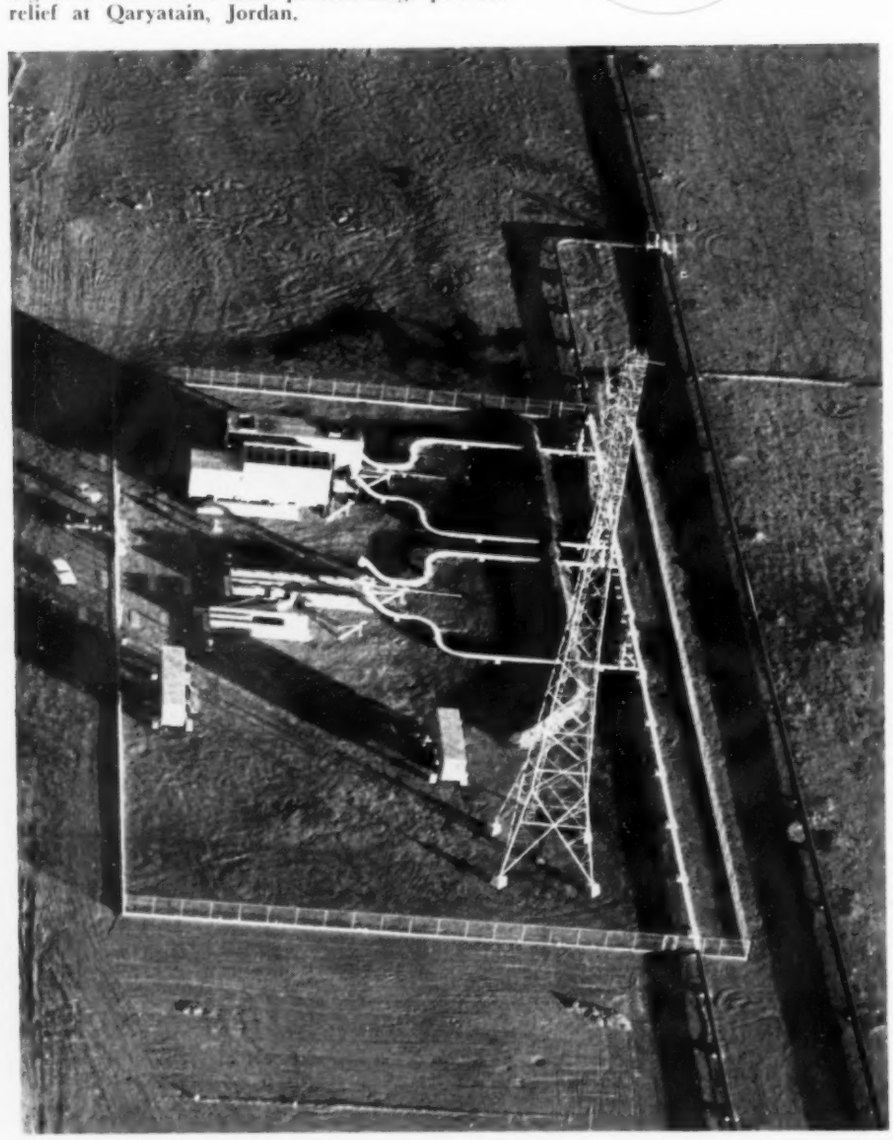

FIGURE 5—Aerial view of unattended pumping unit. Van mounting of units and auxiliary equipment give mobility for maintenance: horsepower costs are about one-sixth that of a manned desert station. Communications system utilizes high power VHF forward scatter transmission.

Turbine-Pump Van. Figure 6 shows a simplified plan view of the turbine-pump van. It is approximately 53 feet long, 15 feet wide, and 18 feet high. The van is divided into two rooms, one containing the gas turbine and the other containing the pump. Rooms are separated by a fire wall, pressurized on the turbine side.

The gas turbine is a two-shaft simple-cycle unit, rated at 5,000-hp shaft output at 110° F. and 2,600-feet altitude. Gas turbines burn crude oil taken from the pipe line. Crude oil contains about 10 ppm of vanadium and requires addition of 0.03 percent by weight of hydrous magnesium sulfate to minimize corrosion of the turbine blades.

A system for blending an aqueous solution of the additive with the crude is contained within the turbine and control vans.

Turbines are started by means of a 200-hp diesel engine with torque converter drive. The engine is coupled to the gas turbine through a jaw-type clutch which automatically disengages when the turbine reaches self-sustaining speed.

Main crude oil pumps are driven directly at gas turbine speed (5,000-6,000 rpm). The pump is an extremely compact unit, with an over-all length of 5 feet, 1 inch, maximum width of 4 feet, maximum height of 4 feet, and a weight of 4,650 pounds. Pumps have the unique feature of weighing less than 0.8 pounds per brake horsepower and delivering more than 600 psi differential with a single-stage impeller.

In addition to driving the main crude pump from the load turbine shaft, the turbine also drives a 125-kva generator from the compressor shaft. This generator supplies electric power for the entire auxiliary pumping unit when the turbine is operating.

Temperature of the cooling water for the gas turbine lube oil system and for critical parts of the turbine is automatically maintained by circulating the water through two closed atmospheric cooling units. Air is circulated through these units by two fans driven by 20-hp motors. During cool-down of the unit, an auxiliary 5-hp d.c. cooler is used.

Over-all weight of this van including all equipment is approximately 125 tons.

Control and Filter Van. Figure 7 shows a simplified plan view of the

control and filter van. This van is similar in construction and has about the same dimensions as the turbine-pump enclosure. The section of the van containing the inlet air filter is open on top to admit air through the filter for the gas turbine, and also for ventilation of the turbine and control rooms. An inlet air filter is of the travelling-screen type with oil bath reservoir at its base. Battery banks and the fire extinguisher system are located on one side-wall of this enclosure. Figure 8 shows this equipment mounted in place.

Control room section of the van contains the basic control panels for the auxiliary pumping unit. Like the turbine room, it is operated at a slight positive pressure to exclude dust and petroleum vapors.

An auxiliary panel which contains the electrical switchgear, motor starters and control relays is mounted in this room. This room also contains the turbine control panel, process control panel and remote supervisory control panel, as well as the voltage regulator, battery chargers, and a 10-kva inverter. The 10-kva inverter is used to supply constant-frequency ac power to some of the instruments, and to supply the basic power for the communication system.

Over-all weight of this van including all equipment is about 84 tons.

Radio Van. Auxiliary station radio vans contain the VHF radio transmitters and receivers and a 30-kw auxiliary diesel-generator set. There are three 250-watt, 150-megacycle, frequency modulation transmitters in each van; two transmitters are for voice, telemetering, and supervisory equipment. The third is for communication with mobile equipment. Tapline's new communication system employs scatter propagation and utilizes extremely high gain antenna arrays mounted on 200-foot-high towers.

When the gas turbine shuts down, an auxiliary generator starts automatically and supplies power to the 208-volt bus to maintain lights, communication, essential services, and a charge on the 800-ampere-hour battery bank. If the auxiliary diesel generator set is temporarily out of service, the station battery, fully charged, is capable of supplying electric power for three complete start-ups and shutdowns of the gas turbine. Batteries also supply power to maintain communications for a pre-selected period of up to one hour. Information transmitted during this period is the basis for making decisions on whether to restart the unit by remote control or whether to dispatch maintenance personnel.

Portable Shop Van. Portable shop vans are divided into two sections. One is a shop and parts storage area equipped with power tools. The other is a personnel locker room area, equipped with an electric kitchen and a wash room for use by maintenance personnel.

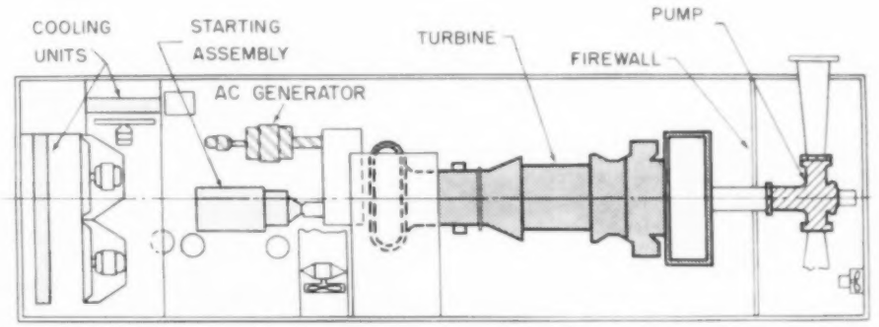

FIGURE 6—Plan view of turbine-pump van shows compactness of design. Firewall separates turbine from pump; the turbine section is pressurized.

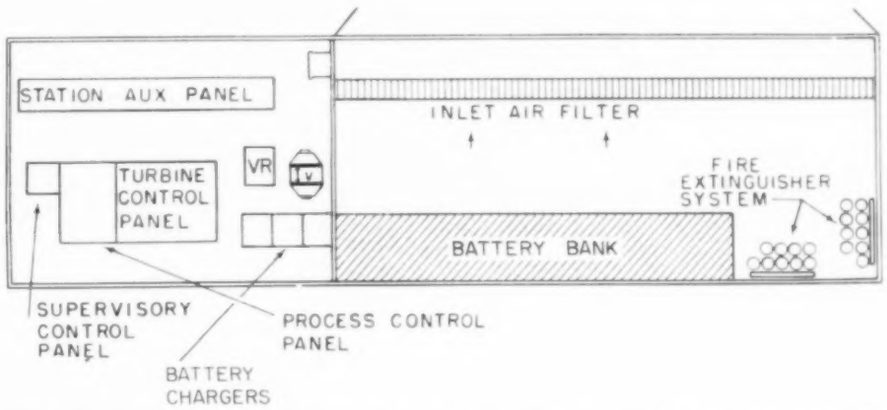

FIGURE 7—Simplified plan view of control and filter van. Battery bank and charges provide emergency power supply. Top of filter section is open.

Control System Design. Figure 9 shows the schematic routing of a control signal initiated from the master supervisory control panel. This panel is located 50 to 100 miles from the operating unit at one of the permanent pump stations. Tapline's supervisory control system is an all-relay, space code selector system. This system provides the means for starting and stopping turbines by remote control, for changing discharge pressure, and for receiving alarms covering important functions.

In addition to the supervisory control, there are four process functions which are telemetered continuously, namely, ambient temperature, discharge pressure, and suction pressure at the auxiliary unit, and discharge pressure set point. Supervisory and telemetering information is carried simultaneously on two independent VHF circuits. Use of two circuits is provided to avoid an interruption of contact between the master station and the operating station in case one of the circuits fails. It also allows the use of diversity reception, which greatly improves the reliability of the communication system.

Details of Control Panels. Figure 10 shows the front view of the master supervisory panel. The top instrument is the ambient temperature indicator. Located directly below is a chart recorder for the process functions. Lower section of the panel contains the supervisory control functions. Basic controls for the auxiliary pumping unit are the start and stop selector keys, the raise and lower set point selector keys, and the selector keys connected to the voice communication channel. These initiate contact

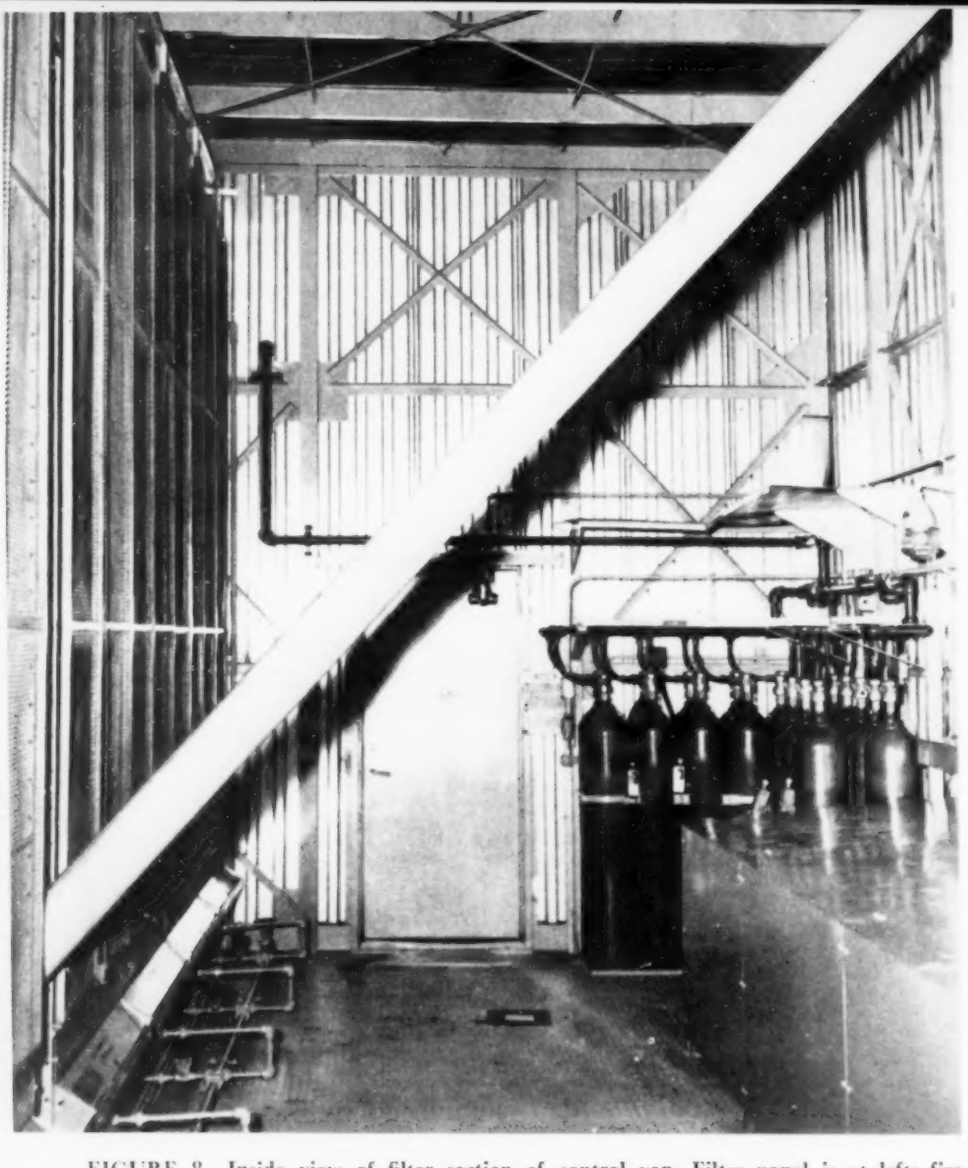

FIGURE 8—Inside view of filter section of control van. Filter panel is at left; fire extinguishers and battery bank enclosure are on the right.

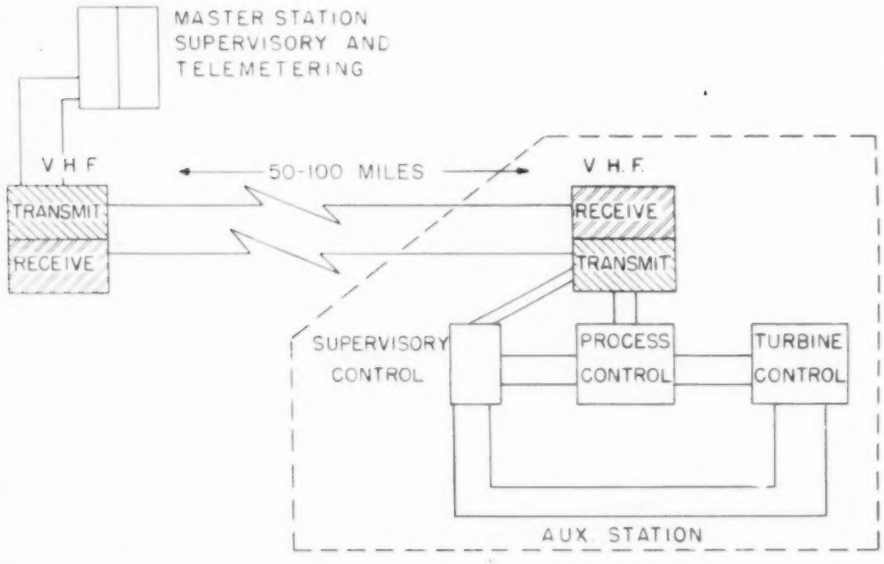

FIGURE 9—Schematic routing of control signals between master station and unattended auxiliary units. Signal paths extend from 50 to 100 miles across desert using high gain antenna arrays on 200-foot towers.

so that a microphone in either the pump room or the turbine room of the operating unit can be heard at the master station.

Alarm System. For transmission to the master station, various indications of malfunction at the auxiliary unit are segregated into three groups, called First Order, Second Order and Third Order alarms. The operator at the master station receives an indication of the group to which the malfunction belongs but is not informed as to the precise nature of the malfunction.

First Order alarms and trips include serious faults such as overspeed, low lube oil pressure, excessive vibration, and fire. The unit trips off for any malfunction in this group. A maintenance man is dispatched to the unit and no effort is made to re-start it remotely until the fault has been located and corrected.

Second Order alarms and trips involve less serious malfunctions such as failure of starting clutch to engage, loss of flame and low battery voltage. When the master station receives this indication, a maintenance man is dispatched to the unit; meanwhile the operator will attempt to start the unit if it has tripped off.

Third Order alarms and trips involve high discharge pressure, low suction pressure and high case temperature on the main line pump. On receiving this indication the unit is re-started or continues to operate. A maintenance man checks the malfunction on his next routine visit to the unit.

Remote Control. One of the most interesting features in Tapline's new stations is the start-up and operation of the unit by remote control. The operator at the master supervisory control first checks to make sure that the panel is clear of alarms and in remote start position. He then depresses the "start" selector key. This action sends a signal to the turbine control panel which in turn sends a signal to the motor starter panel to start the d.c. motors of the auxiliary fans and pumps required for commencing operations. Main line gate valves also open, pressurizing the main crude oil pump.

After a five-minute interval required for purging the turbine van with the d.c. purge fan, the starting diesel is automatically started, the clutch is engaged, and the turbine is accelerated to firing speed. After the

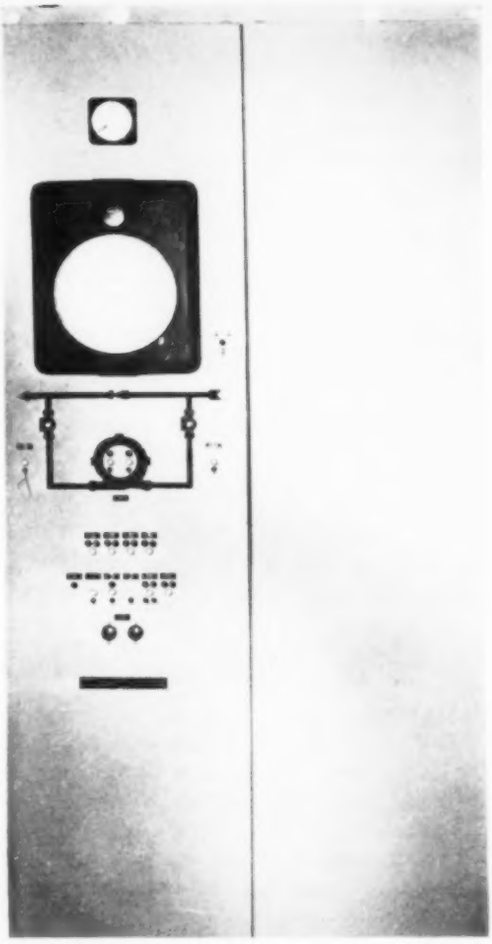

FIGURE 10—Front of master supervisory control panel. Control features three orders of protection of remote units; warning . . . but continued operation, shutdown . . . with remote re-start possible, and shutdown with re-start prevented until station is inspected.

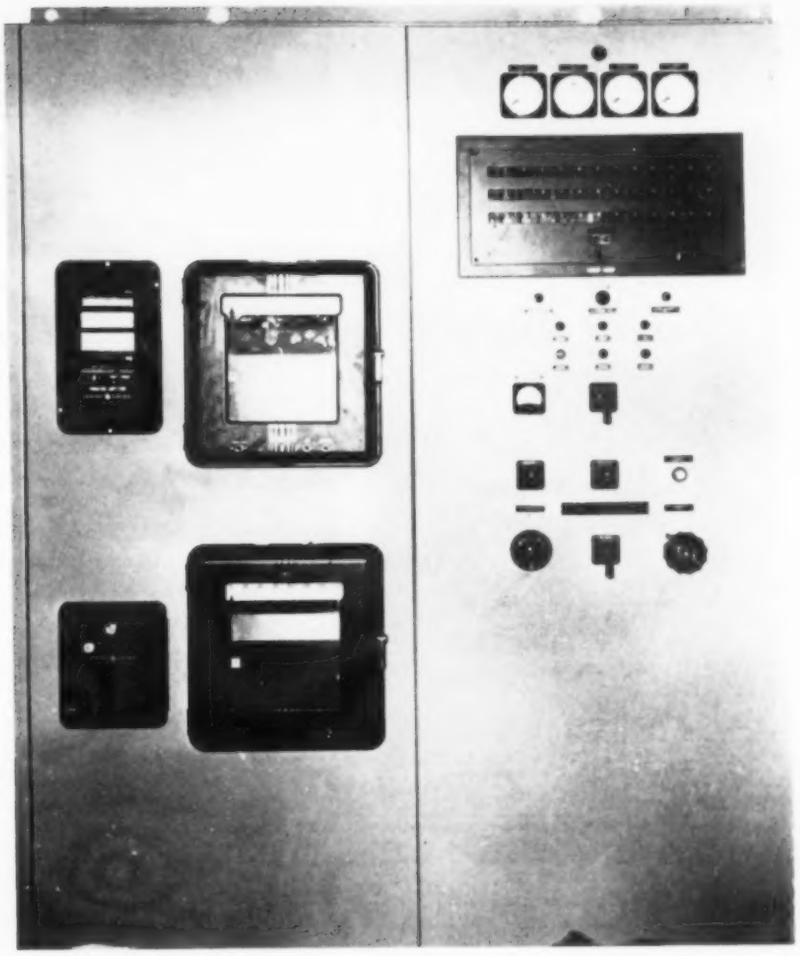

FIGURE 11—The turbine control panel is of duplex construction. A vibration recorder and two temperature recorders are on the left. Turbine control equipment on the right includes speed indicators, nozzle position indicator, fired-hours timers, a 36-point annunciator, and selector switches for local operation.

turbine is fired, it is further accelerated to idling speed. During acceleration, the breaker for the a.c. shaft-driven generator is closed; the a.c. station motors are started in pre-set sequence and the d.c. motors are shut down.

A signal is then sent back to the master control panel, indicating that the starting sequence has been completed. Once the operator depresses the start key, the entire sequence of operation is automatic.

Then the unit is ready for adjustment of discharge pressure set point. This set point is controlled by the operator, who depresses the raise or lower set point selector keys as required. Once a set point has been established, the process control automatically maintains the required pump speed to maintain this discharge pressure until a new setting is called for.

The turbine control panel is of duplex construction. Its left section contains a vibration recorder and two temperature recorders; the right contains the turbine control equipment. At the top are speed indicators of the high pressure and low pressure turbine shaft, second-stage nozzle position indicator, and fired hours timer. Directly below these indicators is a 36-point annunciator panel. Below these are lighting groups indicating the operation of various units, as well as required selector switches for starting, stopping, and operating the turbine locally.

The process control system basically compares a pneumatic pressure established by a transmitter (which converts a process pressure to a pneumatic pressure signal) with an established pneumatic pressure; this is a function of the desired process pressure (set point). If there is a difference in these readings, an "error" signal is sent to the turbine control to increase or decrease turbine speed accordingly.

In addition to the basic controls, there are over-riding features which limit the rate of change of pressure and which limit the minimum suction and maximum discharge pressure to prevent damage to the pump or pipe line.

Equipment in the process control panel consists of two recorders, to keep records locally of various process functions, as well as necessary instruments and controls for operating the process set point locally. Since the basic pressure control system is pneumatic, this signal is converted to an electrical signal for transmission of telemetered information to the master station.

Permanent Pumping Units. Figure 13 shows the pump house containing a permanently installed gas turbine pumping unit at the maintenance base at Qaryatain, Jordan. Its turbine unit and control system are almost identical to those in the auxiliary

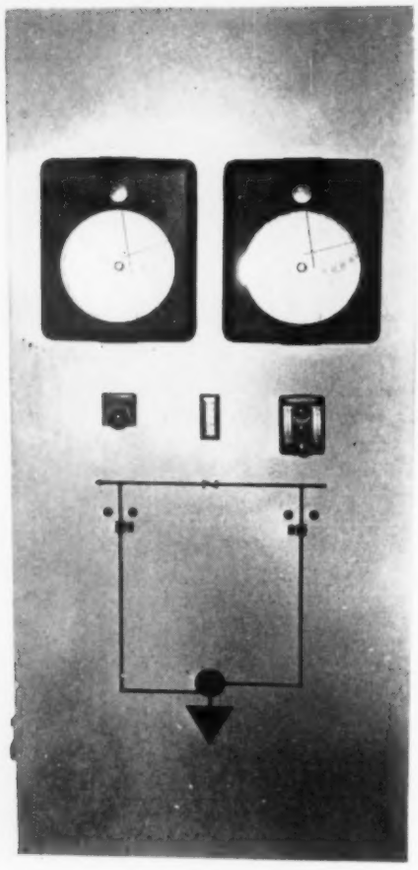

FIGURE 12—Process control system compares a pneumatic pressure with an established pressure that is a function of the desired process set point. Difference in readings signals speed change to turbine.

pumping units. The pumping unit is unattended and controlled from the nearest main station more than 100 miles away.

Installation of two 5,000-hp turbine pumping units at the permanent pump station at Turaif, Saudi Arabia, follows a more conventional pattern with the exception of a unique suction booster pump. When both turbines are in operation, an excess of hydraulic horsepower is utilized to operate a hydraulic turbine-driven booster pump. This provides a suction pressure of 60-90 psig for the main pumps, accomplished by bleeding part of the main oil stream from the station discharge back to the station suction through a hydraulic turbine. Use of this source avoided installation of supplementary generator capacity. The hydraulic-driven pump was supplied as a package unit.

Operation and Maintenance Experience. To March 1, 1958, Aramco and Tapline had successfully operated the gas turbine pumping units for a total of approximately 12,000 hours. Most of these operations were carried out with personnel in attendance, many of whom were present only for possible emergencies or to record pertinent data from non-recording instruments. However, one of the auxiliary pumping units has had several months of unattended operation, with an availability factor of better than 90 percent. Another was successfully operated unattended after a trial run of only 80 hours.

Initial design premises were based on estimates that, with the installation of an additional 180,000-barrel tank at each main station, an operating factor of 80 percent would be realistic for the increment of capacity added by the auxiliary units operating in series with the main pump stations. Experience to date with the auxiliary units has pointed the way to significant improvements in operating factor, and intensive efforts are being made to bring this as close to 100 percent as possible.

Experience also shows that the control and communications equipment requires accurate final adjustments and careful maintenance by specialized personnel, but no major control modifications have been required.

Turbine Overhaul Procedures. Two of the auxiliary pumping unit turbines have been disassembled at their regular locations in order to make adjustments to main bearings and seals. To do so, a crane was moved to the turbine van; after the removal of sections of the roof, parts of the turbine were removed and laid on a canvas on the ground outside and protected by a canvas covering. Although dust storms occurred at frequent intervals, it was possible to do all the necessary work and make final adjustments during periods of clear weather. Such work can only be accomplished by a crew of men who are trained to work under adverse conditions.

Those parts which required machine shop work were moved either by vehicles or by aircraft to and from the central machine shop at Turaif. This shop is equipped with a dynamic balancer, a test stand specifically designed for the turbine control and auxiliary equipment, and necessary shop equipment to handle all parts.

Tapline plans to move each turbine van to the central shop at Turaif for major overhauls. During these occasions the spare turbine van will be installed for temporary operation at the intermediate location.

Minor Maintenance. All equipment in the auxiliary pumping units is new to virtually all of Tapline's maintenance personnel. Accordingly, problems of adjustment, calibration, and trouble-shooting have taken longer to resolve in the beginning stages than they will in the future. Some of the troubles which have been encountered:

- Fuel pump failure caused by sticking plungers. The longest continuous operation of one type fuel pump to date is 1,700 hours. This is a pump of special design having very close tolerances. In an effort to eliminate plunger sticking, experiments are underway to test the lubrication of these pumps at various locations with lube oil, with diesel fuel, and with the crude oil used for combustion. Results to date seem to indicate that crude oil lubrication will afford the best answer.
- Scoring of mechanical seals on main line pumps. Several sets of seals were scored by foreign material at the beginning of operations. A considerable quantity of this foreign material, which had been lying dormant in the pipe line, was picked up when the flow rates increased. Properly designed knockout pots should eliminate this problem.
- Failure of combustion cone clips. Some of these clips have failed, allowing the cones to move and thus causing improper combustion and excessive smoke. The turbine supplier has changed the design and fabricating techniques for these clips to correct the difficulty.
- Recirculation of exhaust gases and lube oil vent vapors. These gases and vapors have been sucked into the compressor intake and have fouled the compressor blades with an oily carbon deposit. To minimize this problem in the future, the exhaust stacks have been extended, and the lube oil vents have been piped alongside the stack extension.

No special troubles have been encountered with the electrical system. Adjustment of contacts, setting of relays, and proper voltage adjustment for controls and motors have all been performed with dispatch. Additional voltage-regulating equipment was re-

FIGURE 13—A permanently mounted gas turbine unit is installed in this station at Qaryatain, Jordan. Qaryatain also serves as one of Tapline's maintenance bases.

quired for critical communications components.

Operating Record Meets Expectations. High-speed main line pumps are now operating with a suction pressure as low as 60 psig. It has been determined that slight cavitation begins at 28 psig at 18,000 barrels per hour flow rate—a much lower pressure than had been anticipated.

During a load test at Qaryatain the turbine load shaft output reached approximately 7,500 brake horsepower. Under the conditions of ambient temperature and taking other factors into consideration, the turbine performance met expectations. With ambient air temperatures encountered along the pipe line, turbine power is expected to range from 5,000 to 8,000 bhp and to average about 6,000 bhp over the course of a year.

After the first 12,000 hours of operation, Tapline is convinced that basically it has a well-designed auxiliary pumping unit, which can be successfully operated by remote control. Equally important, Tapline has been able, by means of careful and selective recruiting, to attract the required personnel who can properly maintain this unit.

Future Application Possibilities. Unattended gas turbine pumping units are an extremely attractive installation, from the standpoint of investment per horsepower, for large power requirements in remote areas such as the Arabian desert. Installed cost of unattended auxiliary pumping unit, including the communication and portable shop installations, is about $1,500,000. This is $250 per brake horsepower on the basis of an expected annual average output of 6,000 bhp or one-sixth the investment per horsepower of a conventional community-type pumping station in Saudi Arabia.

Preliminary operating experience indicates that the auxiliary pumping units will have a high degree of reliability and a relatively low operating cost despite a fuel consumption per horsepower hour approximately twice that of originally installed diesel engines.

Feasibility of unattended gas turbine pumping units definitely changes the economics of pump station spacing for large diameter pipe lines in the Middle East. Because of lower investment per horsepower, the optimum spacing for unattended pumping units will be much closer for a given pipe size than for older, extremely expensive stations of the community type.

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ACKNOWLEDGMENT

Presented at the Annual Pipe Line Conference of the API Division of Transportation, New Orleans, La., March 31-April 2, 1958, under the title "Design and Operation of Gas Turbine Pumping Units of Trans-Arabian Pipe Line Company."

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Olson

Nibley

Walter E. Locher, manager of operations, Beirut, Lebanon, has been with Tapline or its owner companies since 1934. Prior to joining Trans-Arabian Pipe Line Company in 1950, he had been with Lago Petroleum Company as an electrical engineer. In 1941, Locher joined Plantation Pipe Line Company as an electrical engineer, later becoming division superintendent at Baton Rouge. Returning to Creole in 1947, he later became head of Creole's pipe line division in Caracas. Locher was born in Ploesti, Rumania and attended school in Switzerland before studying electrical engineering at Dayton University. He received his B.S. degree from Dayton and an M.S. in electrical engineering from Case Institute.

Arthur E. Olson, construction manager and chief field engineer, Beirut, joined Tapline in 1946. Earlier he had been employed as a civil engineer by the Standard Oil Company of California. Olson was active in the studies which became the basis for design of the Tapline system. Transferring to the construction division in 1947, he has since served both in that phase and in operations. He is a civil engineering graduate of Oregon State College.

Preston P. Nibley, manager of operations, New York City, has been associated with Tapline since 1947. He assisted in the design of the original system and served as chief engineer from 1950 until 1955 when he was named to his present post.

Nibley joined the Standard Oil Company of California following completion of college engineering studies. He received a B.S. degree in petroleum engineering from the University of Oklahoma in 1940 and a petroleum engineering degree from Stanford in 1942.

A SPECIAL

PIPE LINE FEATURE

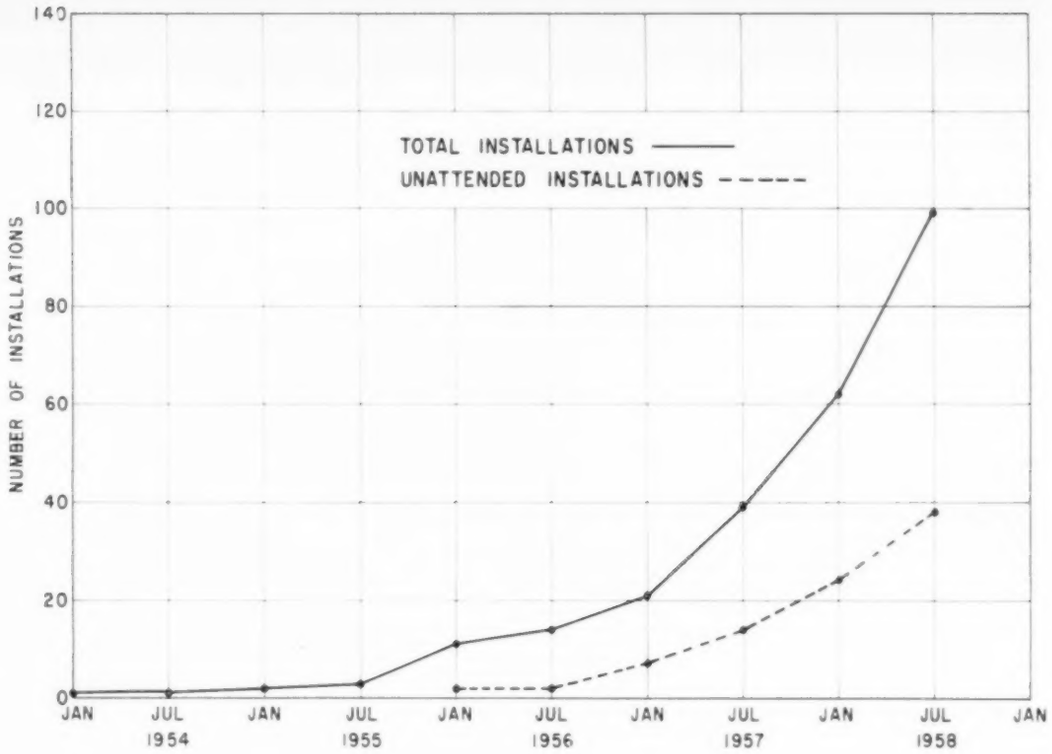

FIGURE 1—The total number of LACT installations has almost tripled each year since 1954. Approximately 40 percent of the total are in unattended operation.

Economic Potential of LACT Unlimited

More initiative by pipe line companies will be required if lease automatic custody transfer is to reach its full potential. Survey of existing systems provides data on economic advantages.

By A. H. Hall, Shell Pipe Line Company, and
H. L. Shatto, Shell Oil Company, Houston

ECONOMIC STUDIES indicate that lease automatic custody transfer has almost unlimited potential application that can net good returns to the industry. This can be accomplished, however, only if leadership and initiative are assumed by pipe line companies as well as producing companies.

Producers are currently making these installations only at locations where it is to their benefit: leases with fairly high production where new tankage is required. So far, these scattered applications have permitted very little net savings to pipe line companies. Further development on this basis alone will restrict the areas of profitable application to the producers and will continue to give little benefit to pipe line companies.

Growth of LACT Rapid. The quick growth in the use of automatic custody transfer equipment can probably be attributed to two principal factors. One is the economic advantage it offers; the other is the atmosphere of cooperation provided by the American Petroleum Institute, through a special study group on lease automatic custody transfer, which the Committee on Crude Oil Measurement established almost six years ago. It was recognized early that because of the numerous groups interested in the transfer of custody of oil from leases, much work would be required to resolve the many directions this development was taking. The Information Bulletin on Lease Automatic Custody Transfer (Bulletin 2509-A), which was published by the API in August, 1955, has provided a useful framework or basis for the mutual agreement which must be reached between affected parties before an installation can be placed in operation.

Survey of LACT Units. Early this year the API committee on LACT prepared a questionnaire in an effort to learn the number and types of systems which are in operation or under construction. The survey is believed to cover nearly all LACT facilities now in operation, under test, or under construction. Data given cover a total of 99 installations, all of which should be in operation by July, 1958, and involve 18 producing companies, 29 pipe line companies, and locations in 12 states and two provinces of Canada. Very few fields have a sufficient concentration of installations to provide an opportunity to study the effect these systems have on pipe line opera-

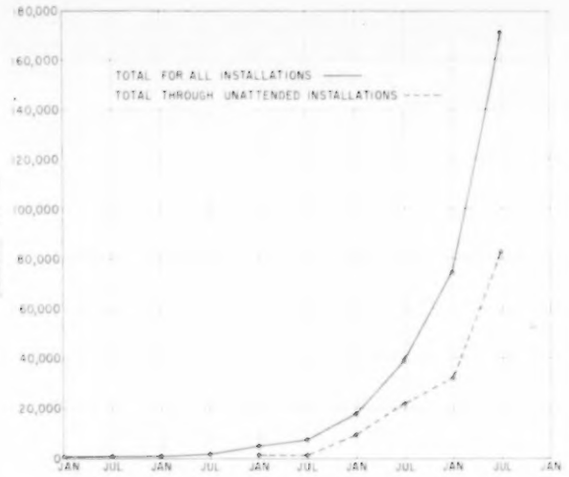

FIGURE 2—Total throughput for 99 systems amounts to 170,000 barrels per day. About half of total is handled by unattended facilities. Total production transferred by LACT installations amounts to less than 2.5 percent of production.

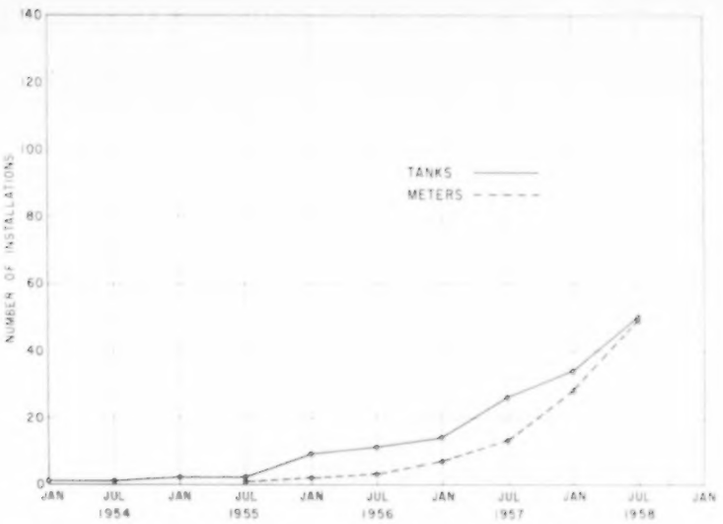

FIGURE 3—Comparative growth of meter systems and tank systems. Tanks held substantial lead in the beginning but by mid-1958 meters should equal tank installations.

tions. Those fields which will have such a concentration, notably those in the Four Corners area, are not yet in fully unattended operation and no conclusions can be drawn at this time.

Figure 1 illustrates the rapid rate of increase in the number of LACT installations. Total installations, including those which are experimental and which are under test for approval prior to unattended operation are represented by the solid line. Note that the total number of installations has almost tripled each year since 1954. Approximately 40 percent of the total installations shown are in unattended operation. The difference between the total number of installations and those in unattended operation is due principally to the lag between construction of an installation and the beginning of unattended operations.

Figure 2 shows the rapid increase in the amount of crude oil being measured by LACT facilities. Total throughput for the 99 systems covered in this survey amounts to 170,000 barrels per day. About half of this total is—or will be by the middle of 1958—handled by unattended facilities. Production to be measured by all LACT installations completed by July 1958 amounts to less than 2.5 percent of the production in the United States and Canada, and less than 1.2 percent of this production will be in unattended operation by midyear. These percentages are not significant in themselves, but if the past rate of growth continues, and there is every reason to believe that it will, a significant share of total production should be in unattended LACT operation within a few years.

Meter Installations Increase. Figure 3 shows the comparative growth of meter systems and tank systems. For over two years tank systems have held a substantial lead; however, by mid-year 1958 there should be approximately as many meter systems in operation as there are tank systems. Total throughput for meter systems will have jumped sharply upward to almost twice the throughput for tank systems by mid-year as shown in Figure 4.

Throughput capacities of LACT installations, which range from 5 to 30,000 barrels per day, are shown in Figure 5. The largest grouping of installations appears to be in the 500- to 1,000-barrels-per-day range, which indicates that automatic operation can be most easily justified in leases having somewhat higher-than-average production. Several of the points shown below the throughput of 100 barrels per day are known to have

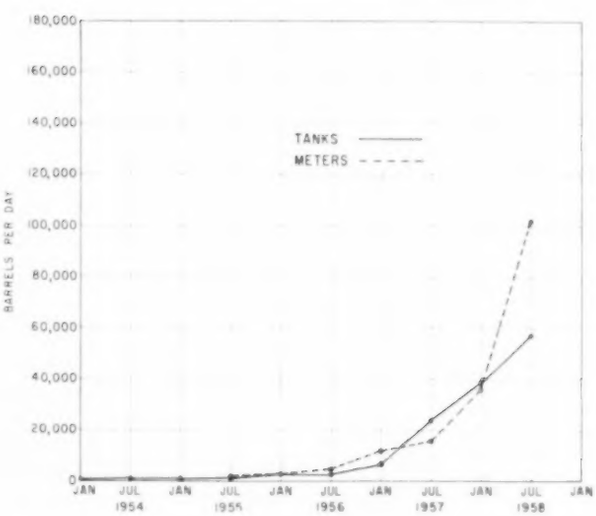

FIGURE 4 (Left)—Total throughput for the meter systems will have jumped sharply upward to almost twice that for tank systems by mid-year.

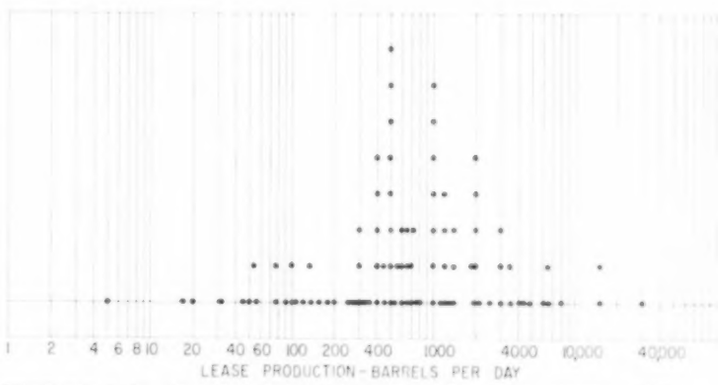

FIGURE 5 (Above)—Size distribution of LACT installations. Capacities range from 5 to 30,000 barrels per day. Largest grouping is in the 500 to 1,000 barrel-per-day range.

OTHER IMPORTANT SURVEY-DATA

- Dielectric BS&W monitors used on 90 percent of installations; non-recording type holds almost 3-to-1 lead.
- 60 percent provide automatic diversion of non-merchantable oil to treaters and 22 percent divert this oil to storage.
- 66 percent shut in production in event of malfunction.
- 60 percent use pipe line pump; in 46 percent of all cases a pump would be required with manual operation.
- Of 13 cases where a pump was used when not required for manual battery, eight are meter systems and five tank systems.
- 60 percent use allowable stop valve; 40 percent schedule runs by time clock.
- 86 percent of units are on leases where oil is heat-treated.
- 91 percent use electrically-operated controls, the remainder are presumed to have pneumatic controls.
- 61 percent of meter installations have only one meter; 10 percent use meters in series; 29 percent use meters in parallel.
- 98 percent of the meters are temperature compensated; 92 percent use ticket printer.
- Meter charging pumps are used in 74 percent of meter installations; air eliminators used in 65 percent; 79 percent use strainers.
- Meters are proved 51 percent by power tank, 31 percent by stock tank, 16 percent by master meter, 2 percent by gravimetric means.

been justified on the basis of completely automatizing given areas in order to permit real labor savings to be made.

Emergency Storage Varies. Much has been heard about the number of days' emergency storage that should be provided with LACT systems. The distribution of emergency storage capacity used with the 99 systems covered in this survey is shown in Figure 6. In many cases it was noted that the manually-operated conventional storage had not yet been removed. It is believed safe to assume that those installations which have, say, about three or more days' storage fall into this category. It is particularly interesting to note the number of installations which have emergency storage capacity ranging below one-third of a day and even down to zero in two cases.

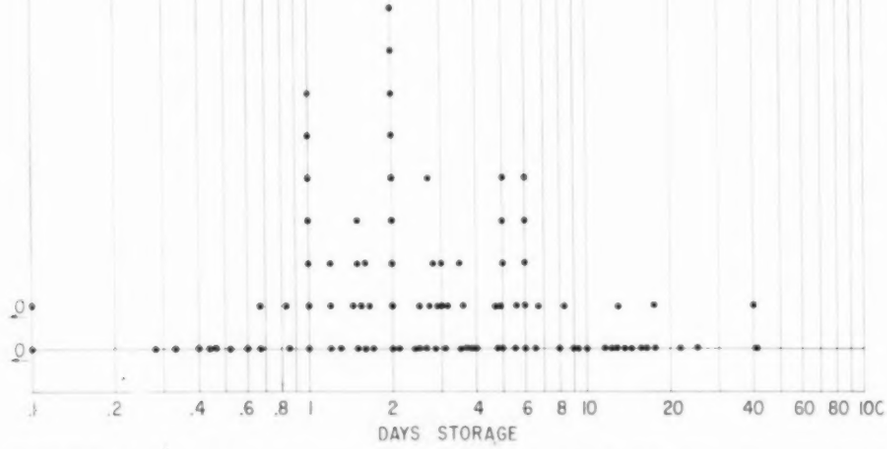

FIGURE 6—Distribution of storage capacity for LACT installations. In many cases manually operated conventional storage has not been removed, which probably accounts for installations where more than three days storage is available.

Inaccuracies Corrected. Two installations were reported unsatisfactory, but a quick check revealed that only minor difficulties, believed subject to easy correction, had been encountered and that these installations were not yet satisfactory for unattended operations. Some difficulties were experienced with positive displacement meters, such as failure of the temperature-compensating element and register shaft decoupling, and a steady drift of meter factor in one installation which had not yet been explained. The latter was presumed to be due either to meter wear or to incrustation in the meter prover tank.

Some "teething" troubles have also been reported in tank systems, which have usually resulted from malfunction of the level sensing devices. In a few cases, sampling has been a problem, but not a very serious one. Some difficulties have developed in sampling the sample container, and some types of samplers have shown an error in proportionality caused by changes in line and sample container pressure. In those unattended installations where run tickets are produced as infrequently as one per month, the operators report pipe line gagers do not find it necessary or desirable to make inspection trips in the interim between their scheduled visits.

From the foregoing information, three important items seem clear. One is that the installations made so far, with few exceptions, have been widely scattered. Another is that LACT has generally been applied to leases having somewhat higher than average production. The third is that the operational use of LACT equipment is growing at such a high rate that immediate consideration by every producing and pipe line company is certainly justified.

Survey Reveals Cost. Information has already been published concerning the cost of LACT systems and the savings that they produce. These costs have shown a wide variation because of the lack of sufficient actual cost figures. Final cost figures are now available on a number of installations that have been completed recently, and the picture is beginning to crystallize. Savings to be

realized from LACT installations are still comparatively speculative, but some new information is becoming available which makes more reasonable estimates possible.

Composite cost curves shown in Figure 7 have been prepared at various throughput rates for meter systems, tank systems, and conventional manually gaged tankage. The curve for manual tankage is based on four days' storage, and the curves for LACT batteries include one-half day's storage plus $500 for an alarm or shutdown system. Estimated curves for the automatic systems are felt to represent realistic minimum costs for good and complete systems. A number of points representing actual costs are shown and, in order to permit comparison, these costs have also been adjusted to include one-half day's emergency storage. Some of the actual cost figures are considerably above the curves for several reasons. In some cases, lower cost equipment is now available to do the same job; in others, the installations were experimental and little attention was paid to cost; and in still others, every possible feature was added to insure successful operation.

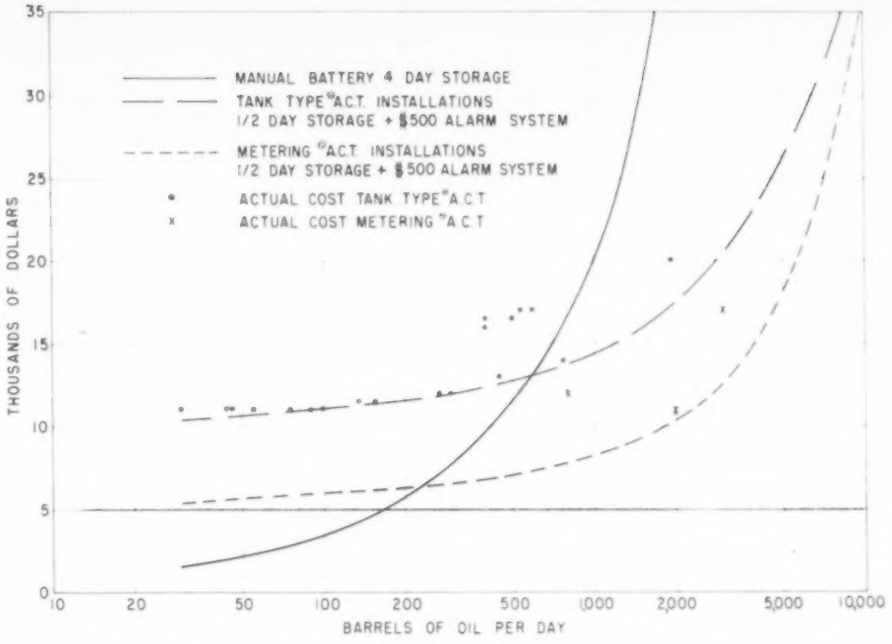

FIGURE 7—Estimated costs of LACT installations. Curves were prepared at various throughput rates for meter systems, tank systems, and conventional manually gaged tankage. Break-even point for tank LACT occurs at about 600 bpd and for meter systems at 250 bpd.

Investment Savings Accrue to Producer. On new installations, the savings in first cost accruing to the producer are simply the differences in cost between an automatic system and a manual battery. The break-even point for tank LACT systems occurs at about 600 barrels per day and for meter systems at 250 barrels per day. In addition to these savings in construction costs, continuing savings accrue through reductions in evaporation losses. By manual gaging methods, these losses are generally agreed to be approximately 0.2 degrees API gravity and 0.5 percent in volume.

Labor savings to the producer are difficult to pinpoint. Estimates have ranged from zero to $200 per month per lease, depending largely upon whether the producer's representative witnesses manual gaging. It can be assumed that this saving is small and could well be offset by additional maintenance costs.

Pipe Lines Save on Operation. Much has also been said about the labor savings which can be realized by the pipe line company through reduction of the frequency of visits for making run tickets and the savings to both pipe line and producing companies through reduction in run ticket handling and accounting. Contact with several companies has produced figures which are thought to be good enough for general estimating. In areas with no appreciable transportation problems and with a reasonable concentration of connections, the direct cost of producing a run ticket by manual tank gaging is about $4 or $5. This cost can be somewhat lower or considerably higher depending upon local conditions.

With modern machine accounting practices the cost of transcribing and calculating a run ticket is about 3 to 5 cents, which for our purposes is negligible. Where calculation of run tickets is done by hand, however, these clerical savings could become significant. Appreciable savings to pipe line companies have also been reported through elimination of the errors associated with paraffin incrustation in tanks; however, since paraffin is a problem only in some fields and to varying degrees, a general estimating figure cannot be given for these savings.

Load Factor Insignificant. Two items, formerly believed to be possible contributors to cost reductions, are no longer considered important in this respect. One is the possibility that more continuous runs from LACT installations would improve pipe line load factors and could, in new fields, permit use of smaller lines. This effect is now thought to be insignificant compared with the unknown factors involved in sizing gathering system lines. The other is the prospect that savings can be made by the use of automatic instruments for measurement of BS&W and gravity, and that these instruments, in conjunction with other data handling and communications equipment, can economically

TABLE 1—LACT COSTS AND SAVINGS

	50 BPD	100 BPD	200 BPD
Cost of meter LACT installation including one day's storage	$5,500	$6,000	$6,500
Manual battery with four day's storage	two 100—bbl. tanks $2,000	two 200—bbl. tanks $3,000	four 200—bbl. tanks $6,000
Direct additional cost for LACT	$3,500	$3,000	$500
Savings to pipeline by connecting, strapping, calculating tank tables, etc., for one tank instead of two or more tanks	100	100	300
Total net additional cost for LACT	$3,400	$2,900	$200
Savings to pipe line by making one run ticket per month rather than one per tank, assuming a cost of $5 run ticket and deducting $10/mo. for meter proving	$60 mo.	$60 mo.	$135 mo.
Value of vapor savings to producer assuming 0.2° API gravity increase-0.5 percent volume increase	$20 mo.	$40 mo.	$80 mo.
Payout from producer savings alone on direct additional cost	14.6 yr.	6.2 yr.	0.5 yr.
Payout from total pipe line and producer savings on total net cost	3.5 yr.	2.4 yr.	0.1 yr.

eliminate manual measurements and provide timely data to central offices.

It is believed that the cost of automatic BS&W and gravity instruments will remain high enough to prevent a payout through reduction of the time required to make one manual measurement per month. The cost of automatic data handling and communications equipment is even higher, and generally lease custody transfer data are not required urgently enough to justify it.

Small Systems Hard to Justify. As mentioned above, the justification for LACT is very clear for leases requiring tankage whose cost is greater than the cost of the LACT system chosen. But a great many leases have production less than the break-even point, and on these the producer's only significant source of return for the added cost for LACT lies in the savings of evaporation loss. As shown in Table 1, this is not enough to justify the smaller systems.

In preparing Table 1, a number of assumptions were made which may have considerable bearing on the validity of the payouts as developed. First, it seems likely that with further development the cost of LACT systems, particularly in the small sizes, might be considerably reduced. Meters for very low throughput rates are not yet available in a quality comparable to that of the larger meters. It is also possible, that on the small systems, more simplified controls with fewer safety shutdown features could be used; and in some cases involving low production rates, some items of equipment might be eliminated altogether.

To pipe line companies, the assumptions made in Table 1 concerning the reduction possible in the number of run tickets is of major importance. The figure used for the number of run tickets made on a manual lease was assumed to be a reasonable average but has not been confirmed by statistical study. Another unknown is the seriousness of the problem the small leases are going to present. Better perspective concerning these two items could be obtained by making studies of random samples of run tickets. Information gained from such studies would also be helpful as a basis for evaluating the empirical information obtained from operating installations.

Keeping these limitations in mind it seems clear from Table 1 that the benefits to pipe line companies might be very significant and could be essential to the justification of automatic installations on relatively small leases.

PIPE LINE LEASE AUTOMATIC CUSTODY TRANSFER POLICY

General—When permitted by state and/or federal law and regulations, the pipe line will receive crude oil on the basis of unattended custody transfer measurement so long as it is satisfied as to the accuracy of the measurement and the ability of the facility to sustain this accuracy. Facilities for unattended custody transfer measurement may consist of positive displacement meters, weir tanks or dump tanks.

Design and Construction—It is the custom in the petroleum industry that the producer furnish required tankage for storage and measurement of crude oil. It is this savings in tankage which allows primary savings in capital investment when automatic custody transfer facilities are installed. In view of this economic factor, the design, construction, and cost of unattended custody transfer facilities will be the responsibility of the producer.

Designs of facilities which are to be used for custody transfer must be acceptable to the pipe line from the viewpoint of engineering and measurement standards as outlined below and must conform to applicable API codes or standards. Further, operations and measurements must allow conformance with governmental regulations. Where the fluid is started and/or stopped automatically, separate control panels must be provided so that controls affecting quantity and quality measurements to the pipe line can be sealed.

1. Volume Measurements—All unattended measurement devices must be capable of consistently measuring volume within 1/10 of 1 percent.

2. Temperature Measurement—When positive displacement meters are used, they may be temperature compensated. When non-temperature compensated meters or tank measurements are employed, temperature recorders must be installed.

3. Mechanical Samplers—When BS&W and gravity determinations are to be made from composite samples collected by mechanical sampler, the sample collected must be representative of the crude oil stream.

4. Merchantable Petroleum Liquid—When there is a possibility that crude oil will not meet required specifications for BS&W, a dielectric instrument must be installed which will automatically stop the delivery to the pipe line of any off-specification liquid.

5. Vapor Pressure and Liquid Stability—In facilities utilizing positive displacement meters, the producer shall supply sufficient head to insure that the liquid being delivered to the positive displacement meters, when the meters are operating at rated capacity, is at a pressure reasonably in excess of the bubble point of the liquid and within the vapor pressure set forth in the applicable tariff. Liquid accepted by meter or dump tank must be stabilized so that subsequent tankage filling losses will be within limits normally accepted by industry.

Pumping Equipment—Accumulator station pumping equipment will usually be installed and operated by the pipe line. Where it is necessary to install auxiliary pumping equipment to furnish sufficient head to unattended custody transfer facilities and to insure flooded accumulator station pumps, such auxiliary pumping equipment will be installed by the facilities owner and the energy furnished by him.

Calibration and Maintenance—The pipe line will provide and operate a portable, volumetric meter prover tank. If it is impractical to transport this tank to the unattended facilities, or a larger tank is required by API standard or desired by the producer, such calibration tank must be provided at the producer's expense as part of the custody transfer facilities. Similarly, only a low-head pump will be provided to empty the prover tank. If high pressures are required to return the oil to the line from the prover, this equipment must be furnished by the producer.

In most cases, the pipe line will assume responsibility for periodic calibration of unattended custody transfer facilities, including automatic controls and equipment used to determine oil properties, to insure measurement accuracy. If desired by the owner, the pipe line will be responsible for maintenance of these facilities and such expense (direct labor and materials) will be charged at actual cost to the owner. These services are considered conveniences rendered the producer, where qualified personnel are available, and the pipe line reserves the right to determine whether or not these services can be rendered. Where calibrations are made by the producer, these calibrations will be witnessed by a pipe line representative.

It is well understood that real operating savings can be made by pipe lines only if the application of LACT is fairly general within a given area. In existing fields there appears to be a likelihood that many leases with low production rates, by obstructing the general application of LACT, may significantly reduce the realization of potential benefits to producer and pipe line companies. In new fields initial production rates may be sufficiently high to justify LACT facilities in nearly all cases.

Pipe Line Initiative Needed. Generally speaking, there are two major reasons for pipe line companies to take a greater share of the initiative and leadership in the application of LACT equipment. First, without such initiative pipe line companies are not in a position to influence the installation of a sufficient concentration of facilities at locations to permit savings to accrue to the pipe line company. As illustrated in Table 1, savings accruing to producer and pipe line companies are of a completely different type. The producer's savings are almost entirely due to a reduction in capital cost, which is far more pronounced on larger systems and which disappear altogether on small ones. The savings to pipe lines on the other hand, accumulate over the years through a reduction in operating costs and are largely independent of system throughput, but are dependent upon the number and concentration of installations.

Producer Owns Equipment. So far, with few exceptions, LACT equipment has been provided by the producer. In only a few cases has the pipe line company purchased any major equipment such as meters or samplers, and for the most part it has been done to permit the pipe line to gain experience with this new equipment. It seems unlikely that any firm decisions will be made concerning allocation of costs until the division in savings becomes more clear.

In the meanwhile, the publishing of pipe line policies encouraging and guiding the application of LACT equipment should stimulate its greater use by producers and can, with proper planning, improve the likelihood that material benefits will be realized by pipe line companies. Of course, this influence could be increased if the pipe lines could find it possible to share in the capital cost of the installations.

Pipe Lines Responsible for Accuracy. The second reason for pipe line initiative stems from the need for pipe line companies to maintain good control over measurement accuracy. Traditionally and logically, and in some cases legally, this control has been and should remain the primary responsibility of the pipe line companies. Certainly, more effective control can be maintained if the pipe lines establish policies which encourage and lead in the establishment of good system designs which will also allow ease in "auditing."

Along with the improved control over measurement accuracy, which can be expected through pipe line leadership, there is the fact that pipe line companies with their relatively large number of connections in a given area are in the best position to provide efficient and well-controlled inspection and calibration services. This is particularly meaningful in the case of meters where pipe line companies might be expected to provide an efficient meter proving service; and, if their savings should warrant it, they might also provide efficient meter and auxiliary equipment repair and maintenance service.

Pipe Line LACT Policy. A consideration of all of the aspects of automatic custody transfer should allow a pipe line company to set forth a policy which provides a basis for negotiation and planning by both producers and pipe lines. Such a policy promulgated by one pipe line company is included in the hope that it will be of some use to other companies in establishing a policy of their own. In considering the drawing up of a policy such as this, the API Bulletin 2509-A on LACT provides a good source of basic information.

While it is recognized that the policy presented here does not make a provision for allocation of capital costs of an LACT system, it does provide that the pipe line company will assume the cost of proving meters where they are used. It is believed that such a policy will encourage the use of LACT in spite of the absence of financial assistance on capital costs. It is intended that this policy be reviewed from time to time as more information is gained on the extent of pipe line savings, and it is recognized that new developments may require its revision in the future.

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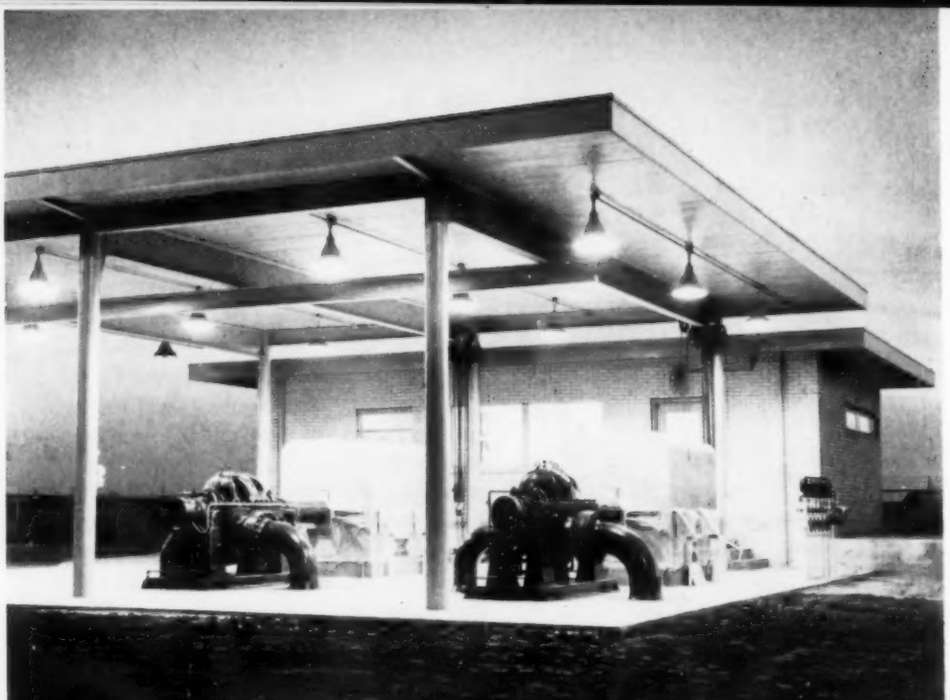
A SPECIAL

PIPE LINE FEATURE



Modern closed pipe line systems with electrically driven centrifugal pumps require close attention to power demands when pumping crudes of varying gravity and viscosity. Constant attention and necessary adjustments by the dispatcher can keep power costs at a minimum.

Dispatcher's Role in Controlling Expenses

His attention to power costs, equipment usage, scraper scheduling, manpower costs and leakage action make for efficient, low-cost operations.

By Fred M. Springer
Magnolia Pipe Line Company, Midland, Texas

To MANY pipe line men the word "dispatching" means an hourly and daily recording of information—an accounting of operations on a permanent record. Often taken for granted is the more important dispatching duty of continuously analyzing and interpreting these data and translating it into efficient operation of the pipe line system.

Efficient physical operation of the line is the dispatcher's primary responsibility. An up-to-the-minute account of operating conditions is essential to the accomplishment of this purpose. But of equal importance is his job of controlling operations so as to reduce operating expenses while maintaining efficiency and safety.

Perhaps the reason that we hear so little about effective dispatching as an instrument of cost control lies in the fact that the dispatcher's influence upon costs is not revealed in the ordinary cost analysis. The dispatcher must be trained to recognize these hidden costs in order to minimize them in the performance of his daily tasks.

One of the biggest problems in organizing an efficient dispatching department is the thorough training of the dispatchers. A new dispatcher is so engrossed in the details of proper accounting and recording of data that it is difficult to impress upon him the importance of using it.

He must be trained to recognize the effects of light and heavy grades during displacements, the wasting of power through ineffective use of a pump's capacity, causes of pressure drops and what to do about them, value of time and schedules with respect to terminal and refinery requirements, and the effect and limitations of control equipment, to mention only a few.

He must have a thorough knowledge of pipe line hydraulics, training which the average pipeliner does not receive. Of course, he does not need the detailed knowledge that the engineer has, but he must be able to calculate pressure loss, determine head pressure, calculate displacements and be able to determine the pressures required under specific operating conditions.

He must also be familiar with the different types of pumps and machinery in order to operate the proper combination of equipment in a particular situation.

Reducing power costs. Considering the large trunk lines in operation today and the increasing use of closed systems and electrically driven cen-

rifugal pumps, one of the most common hidden costs in pipe line operations is the waste of electrical power. This cost slowly creeps upward in virtually unnoticeable increments unless the dispatcher keeps a constant watch on operations and learns to recognize the causes when they appear.

An instance in which this may occur is the handling of displacements of a particularly light grade against an extremely heavy grade. Difference in viscosity of the two grades will cause considerable variation in pumping conditions as the grades move through the system. The viscuous crude will slow the line down to the extent that the stations pumping the light crude will be using excess power unless the dispatcher makes continuing adjustments at all stations to keep the line operating most efficiently under the circumstances.

This type of situation could result on a line in which 40 degree API gravity oil is batched against a heavier 30 degree API gravity oil of much higher viscosity. As the light crude displaces the heavy, the line will slow down to the extent that the control valve at the station closest to the displacement will be pinching heavily on the second pump of a two-unit station. Here it is possible to shut one unit down and operate on high suction pressure until the displacement has moved a sufficient distance down the line to allow for efficient two-unit operation again. Power savings in such a situation would increase with the frequency of displacements and would depend upon the length and size of line as well as the size of pumping units.

Scheduling scraper runs. Another source of wasted power is the dirty line where internal corrosion, paraffin, dirt or other foreign matter causes an undue pressure loss between stations. This will cause higher pressures and resulting higher pumping costs; more economical operation is possible with a properly maintained scraper program. A proper scraper program does not necessarily mean an "every-two-weeks" type of schedule, but a flexible program in which the dispatcher or his supervisors run scrapers to the best advantage.

It is equally important to be able to recognize the danger signs which point to the need of a scraper run. Waiting until the line slows down or until pumps are operating inefficiently is to wait too long; it takes an alert and well-trained dispatcher to recognize the danger signs in their early stages.

Scraper scheduling becomes especially important in a cold climate where a paraffin type crude tends to leave heavy deposits on the walls of the pipe line in winter months. An effective scraper program will result in a decided increase in line throughput and efficiency.

Increased throughput pays out. An increase in volume handled of only 1,000 barrels per day would result in a substantial increase in tariff revenue, as well as lower operating costs per barrel. On an assumed 15 cents per barrels tariff, this would amount to increased earnings of more than $50,000 per year on the 1,000 barrel per day increase alone.

Selecting pump combinations. When lines are operated below capacity, the dispatching department must make a careful study of the line requirements and the horsepower available in order that the most efficient pumping combination may be used. It is very easy to run too much equipment and waste power by pinching or bypassing on the pumps for the desired throughput. This is a situation against which the dispatcher must constantly guard.

Often, no one pump or combination of pumps will give the required throughput; in which case units must be alternated and the line increased and reduced to give the desired capacity while still utilizing all the horsepower available. An illustration of this type of problem would result when a line schedule of 120,000 barrels per day is required for a line of 130,000 barrels per day capacity. To reduce the line to the next lowest pump capacity would result in a throughput of only 100,000 barrels per day, which would not be sufficient to meet the demand.

The obvious recourse would be to operate the equipment for 130,000 barrels per day rate and bypass or pinch for the desired throughput. Horsepower wasted by such a schedule would result in a sizable increase in operating costs, even for only a 30-day period. A more efficient solution would be operation of the line at the 100,000 barrels per day rate, increasing to the full capacity of 130,000 barrels per day on certain days or for certain periods to give the required average for the schedule period at the lowest operating cost possible.

Knowing just when to run scrapers in lines that handle a high paraffin crude at low temperatures is another way the dispatching department maintains high throughput with optimum pumping costs.

Consider equipment conditions. Dispatching must make a constant review of pumps and pumping equipment to be certain that the most efficient type of installation is being used and that units are operating at their rated capacities. This includes recommending changes in liners or impellers where necessary to give the required throughput; it is especially important where lines are operating below capacity for extended periods of time or where future forecasts indicate decided changes in line operations. Constant analysis can result in substantial savings through more efficient operation and use of pumping equipment.

Savings that can be realized by this type of analysis would be on a long closed system line with identical pump stations. If one of these pumps is failing to develop the required pressure for any reason, that one unit will serve as a bottleneck for the entire line; reducing throughput and increasing operating costs at all other stations. Close analysis of the day-by-day operations of this line will reveal such a situation and result in the necessary corrective action to increase throughput and lower costs.

Standby power costs. There may also be instances when a station on

lines operating below capacity is subject to a standby charge for power whether operating or not. Such situations should be thoroughly checked by the dispatching department when deciding upon the pumping combination for the line. In order to accomplish this, the dispatching department must be kept informed of power contracts and the particular clauses that they contain.

It should be pointed out that for each 1,000 barrels per hour of throughput, one pound of pressure wasted is one-half horsepower wasted. If the dispatcher watches the line and pumps closely he will aid in controlling operating expenses by eliminating, or at least keeping to a minimum, the waste of horsepower and power cost.

Manpower savings. Through its scheduling of pipe line operations the dispatching department has a direct bearing on the work and assignment of personnel. This gives the dispatcher a definite responsibility in the control of labor costs, a major operating expense.

Where a pump station is operating below capacity, it may be possible to reschedule line operations to permit the station to operate on a part-time basis. There are also occasions when careful scheduling may permit a station to shut down on holidays, weekends or other special days. The saving in premium pay for one holiday at one-man-per-tour station would amount to approximately $100. Considering all the possible pump stations and holidays, this one item alone would bring a sizable reduction in operating costs.

Early action in emergencies. These two areas are not the only ones in which dispatchers influence manpower expense. In directing activities during emergencies and scheduling special work and projects, the dispatcher must consider labor costs.

During emergencies the task of directing personnel becomes the dispatcher's responsibility, at least during the early stages. In his position of coordinating the entire system's operations, the dispatcher has a better overall picture of the emergency than the local personnel. Therefore, he is in a position to direct the needed personnel without sending more than is required.

When scheduling special work and projects, the timing of pipe line movements will greatly affect the work requirements of field personnel. Proper scheduling of a project results in a minimum of shutdown time on the pipe line system as well as reducing manpower requirements and overtime to a minimum.

Efficient scheduling of operations serves to reduce manpower costs with respect to deliveries to other companies, scraper operations, cleaning settling tanks and other routine work. This is especially true of mechanical or electrical jobs where the line schedules must be revised to allow the work to be done. In many cases, the request for work is initiated by the dispatcher, thus he determines the urgency of the request. Often the line operations can be adjusted to prevent any overtime work, or at least keep it at a minimum level.

Accident leakage. One of the most important duties of the dispatcher is the control of shortage and accident leakage. This is wholly a dispatching problem, requiring a thorough knowledge of dispatching and of the line being dispatched. An experienced dispatcher has a complete working knowledge of the pipe line system he is handling and keeps close at hand those maps and profiles necessary for quick reference.

The most common indication of a leak is a drop in pressure. However, we have found that only about 5 percent of all pressure drops turn out to be leaks. The balance can be traced to some specific operating problem, such as loss of suction pressure, air or vapor pockets and equipment failures. In any event, the dispatcher must make a quick decision as to the cause of the pressure drop. If he determines that there is a leak, he must act immediately to prevent excessive loss.

When notified of a pressure drop the first recourse is to walk or fly the line in an attempt to locate any leaks. Considering that only a few pressure drops are actually caused by leaks, a considerable saving can be realized in the use of patrol planes and line walkers. A patrol plane ordered out on the line when the pressure drop is caused by a vapor locked pump can be very costly, while on the other hand a patrol plane not ordered out in the case of an actual leak can be ever more costly. Discretion rests with the dispatcher for he is in a position to analyze the situation and decide the proper course of action.

Meeting future demands. Every pipe line operates to supply a consumer with a specific product, whether it be crude oil to a refinery or gasoline to a sales terminal. In any case, advance planning is necessary in order to handle the demand in the most efficient manner. This requires that the supervisory personnel of the dispatching department stay advised as to future requirements at refineries and terminals as well as informed of all proposed expansions, repairs and connections to the pipe line system. They are then able to schedule operations to produce the required throughput and deliveries at a minimum of cost, as well as recommend alterations in the physical system to meet demands efficiently.

It should be remembered that the dispatcher is the only person in the pipe line organization who maintains constant contact with all of the company operations. His decisions, often made without advice but upon his best judgment, are the key to the efficient daily operation of the pipe line system. If he is properly trained in his work and has a thorough knowledge of all aspects of pipe line operation, his decisions will result in efficient, economical pipe line operation.

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About the Author

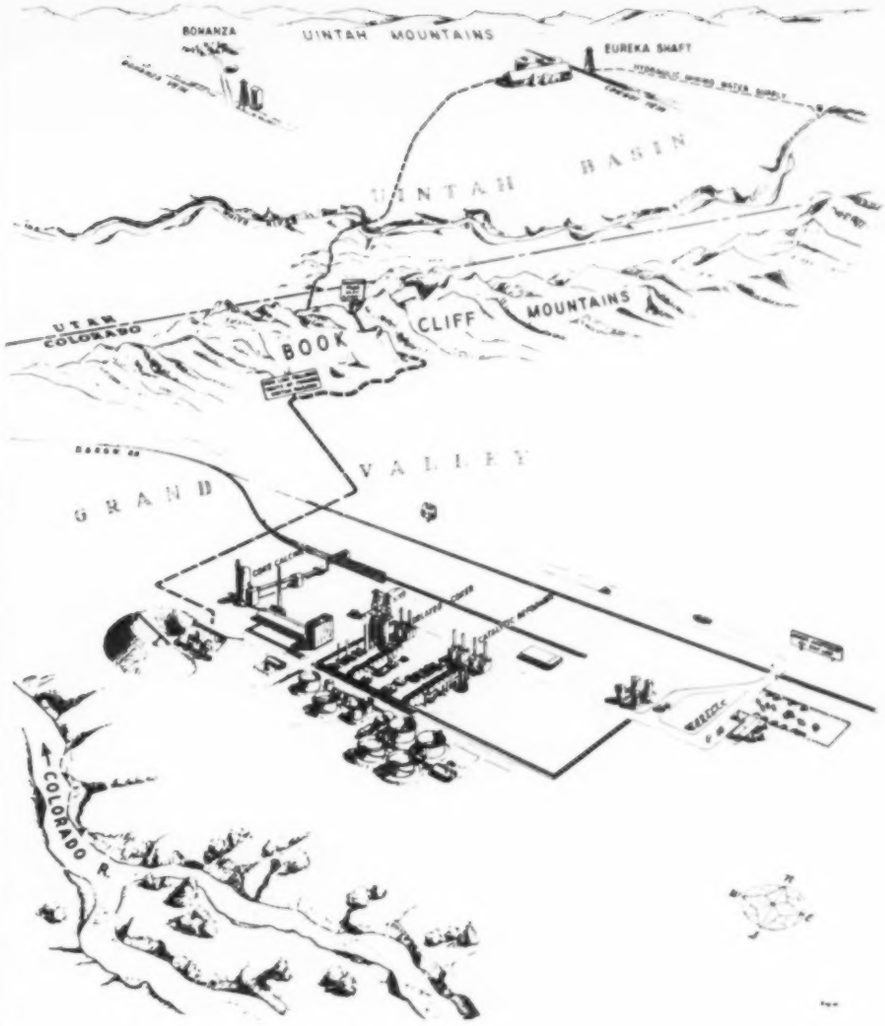
Fred M. Springer, division engineer of Magnolia Pipe Line Company's Western division, has had close contact with dispatching problems and training of dispatching personnel. During a three-year assignment in Magnolia's Oil Movements department in Dallas, he prepared operating instructions for dispatching personnel. Springer has been with Magnolia since graduation from the Missouri School of Mines and Metallurgy in 1949 with a degree in mechanical engineering. He is a member of the American Society of Mechanical Engineers and of the Society of Petroleum Engineers of the AIME.

A SPECIAL

PIPE LINE FEATURE

Gilsonite Line Marks First Year of Operation

Operating experience confirms findings of advance research on slurry flow and pumping problems. Out-of-pocket expense of handling 170,000 tons of crushed gilsonite has been only 2.5 cents per ton mile.



Artist's sketch of the Gilsonite pipe line system between Bonanza, Utah, mine and the refinery at Grand Junction, Colo. Two overhead river crossings and sharp climb over the Bookcliff mountain range complicated design of line to avoid "freezing." First year's operation confirms findings of pilot research studies in flow and pumping of slurries.

By John H. Henderson, Jr., American Gilsonite Company, Grand Junction, Colo.

American Gilsonite Company has been operating a slurry pipe line for almost a year. This 6-inch diameter, 72-mile line carries more than 700 tons of gilsonite per day from mines located in the Uintah Basin of eastern Utah to a refinery near Grand Junction, Colo. There the solids are separated from the carrying agent, water, and refined to high purity electrode coke and motor gasoline. Mining operations are at Bonanza, Utah.

This is the first privately financed project to produce, on a large scale, conventional petroleum products from a raw material other than crude oil. Gilsonite should not be confused with oil shale, which occurs in extensive deposits nearby. Unlike oil shale, the gilsonite occurs in pure form and does not require extraction from rock or sand formations.

No cross-country, solids-handling pipe lines were in existence when the decision was made to design this system. It was necessary to develop the fundamentals of design from original pilot-scale tests. Hydraulic work was done at the Colorado School of Mines Research Foundation at Golden. Tests of pumping and dewatering equipment were made by equipment manufacturers in the United States and Germany. The commercial pipe line was designed by careful appraisal of these results with application of safety factors.

Early Commercial Operations. Since the turn of the century, gilsonite has been processed for use in paints, inks, floor tile pigments, and insulation material for buried piping. In 1904 a narrow gage railroad was constructed to transport the material to Mack, Colo., about 20 miles northwest of Grand Junction. Incidentally, the present pipe line route parallels this abandoned road bed over the Bookcliff Mountains.

Economic Role of Pipe Line. In 1954 it was demonstrated that gilsonite, when melted, could be converted into coke and gasoline by delayed coking. However, to be commercially

successful, raw and processed materials would have to be handled on a far larger scale than during previous operations. Due to the remote location of the mines, the cost of transporting the products to marketing areas and to rail facilities for further shipments was found to be the greatest economic factor in deciding if and where such a refinery could be built.

Various refinery locations were considered. A refinery could be built at the mine and the finished products trucked to the nearest rail connection and gasoline consuming areas. Or, raw gilsonite could be transported to a refinery located near these shipping and marketing centers. This of course required moving appreciably more material, but would locate the bulk of the operating plant near communities where labor, privately owned housing, and schools were available.

Ideal location for the refinery was near Grand Junction; however, the truck haul over all-year highways would have been almost 200 miles. Geographically, Grand Junction lies only about 80 miles from Bonanza, but beyond the Bookcliff Mountains, which rise from 8,500 to 10,000 feet above sea level. It would have been far too expensive to construct an all-year trucking road or to re-install the railroad over this direct route. However, the terrain was not unusual for a petroleum pipe line handling liquid crude oil or products. The temptation to pump the solids in a water suspension and thus take advantage of the direct route and proven economy of pipe line transportation was irresistible.

Water Available for Slurrying. Adequate water supply was available near the mine. Gilsonite's specific gravity is only 4 percent greater than water. Also, its nonabrasive properties indicated an ideal slurrying material. In addition, the increased scale of the mining operation required replacement of the old hand methods with hydraulic ore cutting. A powerful jet of water is used to cut the gilsonite ore from the vein. Additional water flumes the shattered ore horizontally for more than a mile to the bottom of a central shaft approximately 800 feet deep. Here the ore is screened and pumped to the surface. Thus the slurry, to a large extent, would be already prepared for pipelining.

The company had some experience handling gilsonite slurry in a short line. Literature contained some flow behavior data, but about much heavier materials. Still it was possible to set up a tentative design basis and to make what was felt to be a reasonably safe cost estimate of proposed facilities to see just how attractive a pipe line might be. This study showed clearly the economic advantage of the pipe line over other means of transportation.

Relative to trucking, savings of over $4 per ton in over-all direct operating cost could be realized, amounting to about $1 million per year, and easily justifying the additional $2 million investment required for the pipe line system. Because of the geography of this area, pipe line distance is far shorter than the highway distance. Had the distances been comparable, economy of pipelining would have been less attractive. However, pipe lines are frequently much shorter than truck or rail routes, especially in rugged western country.

Preliminary Research. Convinced of the practicability of the project, a refinery site was selected, engineering designs for the processing facilities started, and a test program undertaken to determine the engineering data needed to design the pipe line system. Testing was in two parts, that required for the pipe line system, and that required for the pumps and other equipment.

Pipe line tests were made at the Colorado School of Mines Research Foundation. A 500 foot loop of pipe was constructed, and gilsonite slurry was pumped around and around through it simulating the 72-mile length of the pipe line. In this way the interrelationship of friction, flow velocity, slurry concentration, initial size gradation, degradation through the length of the pipe line, pipe diameter, corrosion, erosion, temperature and use of chemical dispersants was determined.

Many tons of slurry equivalent in particle size to that expected from the pipe line were thus "manufactured" and "canned" in 50 gallon drums. This material was later sent to manufacturers of filters, centrifuges, dryers, etc. in the United States and in Germany, to test the applicability of their equipment for dewatering the slurry.

Meanwhile, pumping tests were made by a leading U. S. pump manufacturer at Braddock, Penn. Frames of standard positive displacement pumps used for oil well mud pumping were equipped with several types of pistons, valves and seats, and run at various speeds.

This test program was set up to explore only the problem at hand, and no attempt was made to conduct a research program to establish general relationships for all the variables involved. The program required only a little over six months to complete and was conducted at comparatively small expense.

Expanding to Commercial Scale. Data obtained from the pilot tests required very careful judgment, extrapolation and interpretation before they could be applied to the design of the commercial installation, particularly because of the great difference in scale. The test loop was only 1/750th as long as the commercial line; however, the pipe used was the same diameter.

To test the pumping characteristics of the slurry for several hours required two carloads of material, making it impractical to obtain operating data for extended periods of time.

Pump tests were made with a pump almost full size and operated with slurry at discharge pressures as high as 2500 pounds per square inch. This required a pressure breakdown system which rapidly degraded the material until after 15 minutes of operation the particle sizing was no longer representative of the feed material. Because of these unavoidable restrictions in testing and because little operating experience was available, it was believed prudent to allow an ample safety factor in the design of the full scale pipe line.

Operation Proves Design. Design contemplated a pump volumetric efficiency of 88 percent required for a minimum pumping rate of 325 gallons per minute, a solids concentration of 35 percent resulting in 700 tons per day, friction significantly above that of water resulting in a station discharge pressure of 2300 psi, and some attrition of particle size in transit. Actual operation shows a volumetric efficiency of 95 percent resulting in a pumping rate of 350 gpm with a solids concentration of

32.5 percent required for the design amount of 700 tons per day.

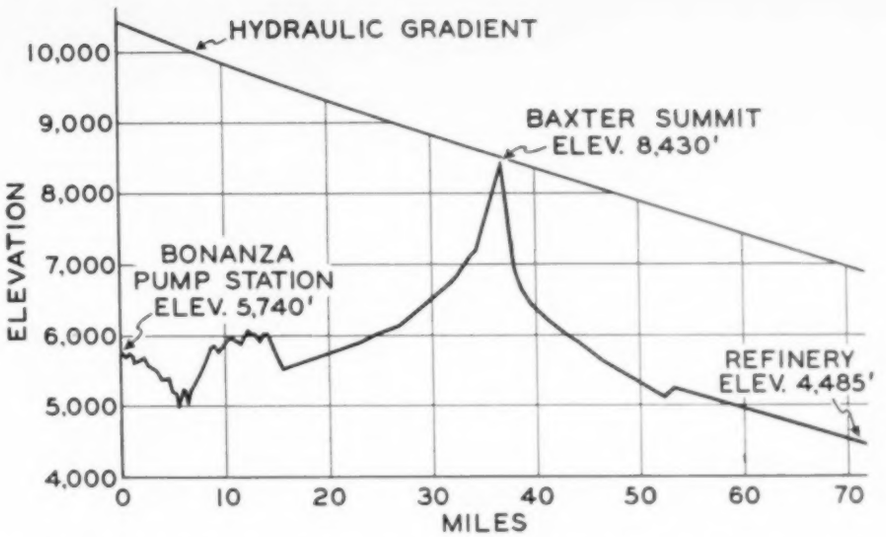
Concentrations as high as 40 percent, or 850 tons per day, are regularly handled with no loss of volumetric efficiency. The friction factor is approximately that of water so that the station discharge pressure is 2150 psi at the increased pumping rate. Attrition is negligible; the slurry is easily filterable with 100 percent recovery.

Initial Particle Sizing. Size consist of the gilsonite particles in the slurry was found by the test work to be significant in establishing the pipe line hydraulics, pump operation and the amount of "dusting" or attrition of the particles in transit. More specifically the maximum particle size that was allowed in the feed slurry was of extreme importance. Fortunately, gilsonite is a relatively friable material and easily crushed with fairly uniform distribution of all sizes.

It was found possible to pump slurry with conventional, positive displacement type pumps with a ¼-inch top particle size. However, improved volumetric efficiencies were obtained when an 8-mesh top size feed was used. Another advantage in the smaller particle sizing was reduced degradation, caused perhaps by abrasion of the larger particles against the pipe wall and against each other when subject to the turbulent flow conditions in the pipe. Although it would appear to be directionally wrong, the smaller top particle sizes appear to create less fines in the effluent, thus making dewatering easier.

Finally, as one might expect, smaller particles are easier to maintain in suspension. The gilsonite pipe line is designed for no more than 5 percent of the particles to be in the 4 x 8 mesh range. This control is still used, and the volumetric efficiency of the pumps does not appear to be affected adversely by this amount of "large" particles.

Pressure Drop-Flow Velocity. The pressure drop-flow velocity curves obtained in the pilot tests showed the same characteristic form found in published reports by other investigators using heavier solids. Pressure drop was primarily found to be a function of flow velocity, approaching that of clear water at high rates.



Line profile and hydraulic gradient plot of the American Gilsonite line point up the need for maintaining slurry flow. Operation is normally continuous, but if necessary the line may be flushed from either the Bonanza pump station, the refinery terminal, or Baxter Summit. Reservoir at that high point is insurance against plugging of the line.

As the velocity was increased, the pressure drop tended to be increasingly higher than the corresponding pressure drop for water until it appeared to level off and be substantially independent of the flow. At extremely low velocities, a uniform suspension was no longer achieved and flow became unstable.

Pressure drop is also a function of particle sizing, solids concentration and temperature. However, testing was limited to a narrow range of these variables because of practical considerations. The principal aim was to establish a minimum safe velocity. This was determined to be 3.4 feet per second, the point below which the exponent in the velocity-pressure drop relationship began to change.

Minimum wall thickness of the 6-inch pipe is 0.188 inch, so the design pumping rate of 325 gpm was established to give this minimum velocity in the largest internal diameter section. Establishment of an adequate minimum design velocity was, of course, of the utmost importance, in order to insure that none of the particles be left behind and eventually plug the line or cause substantial increase of the pressure gradient.

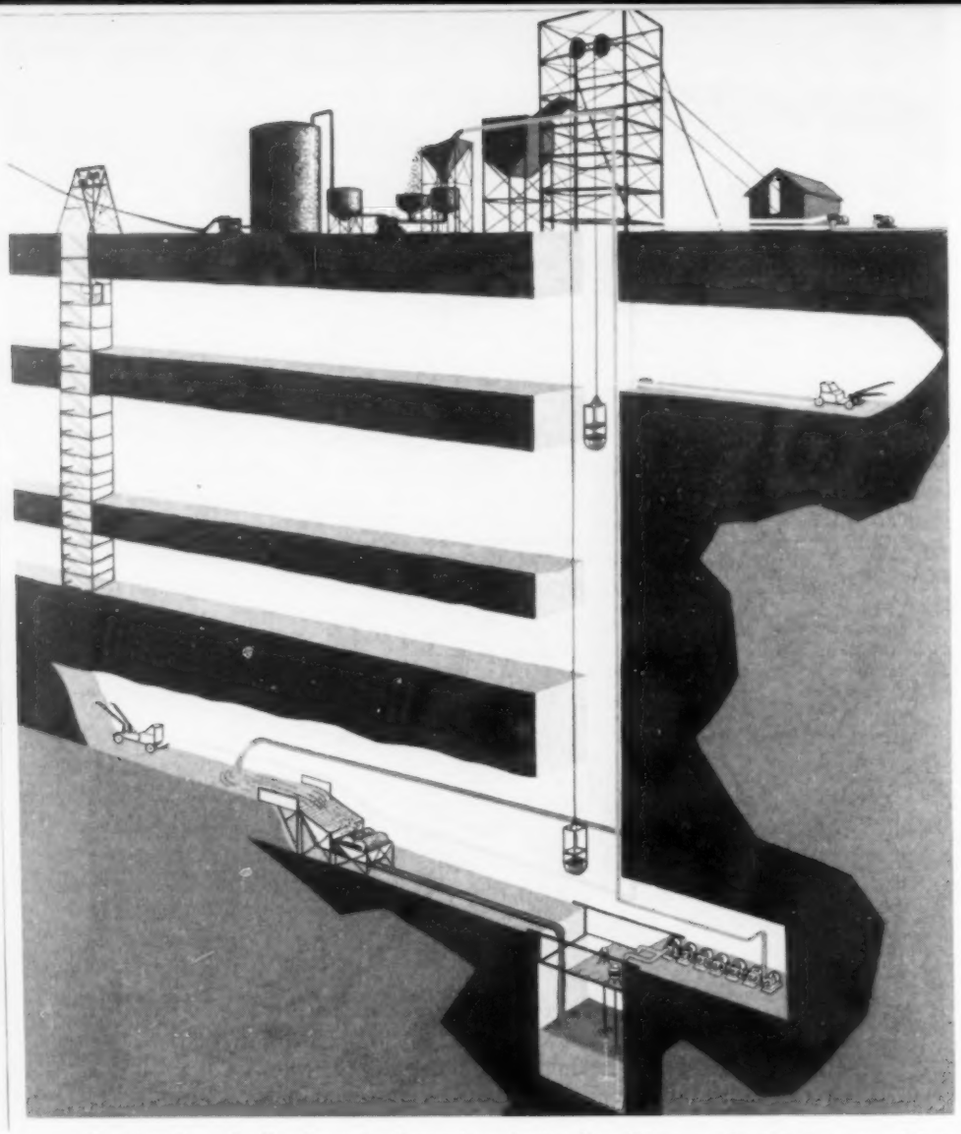
Friction Factor. Test work indicated the friction factor of the slurry to be somewhat above that of water. The pressure gradient used as a design basis was set at 25 percent above that established by the test work in order to give a reasonable allowance for variables that could not be fully explored. This resulted in the use of 0.375-inch wall thickness pipe at the Bonanza end of the line and a design pressure and pumping capability of 2500 psi.

Actual operation of the line shows the pressure gradient to be about that of water. Deterioration of the internal pipe surface is not expected since the test work showed that the slurry particles will keep the wall clean. Also, corrosion-inhibiting chemicals are used.

It has been definitely established by sharp water-slurry interfaces and scraper runs in water batches that no particles are left behind.

Pump Volumetric Efficiency. On the basis of test work done at the pump manufacturer's plant, a pump volumetric efficiency of 88 percent was established for the design basis. This figure was, of course, strongly influenced by the type of valve used. A spherical steel valve working against a narrow seat made of a hardened insert was found to give hope of longest valve life. However, as stated earlier, these tests could hardly be considered typical of ultimate operation because of the rapid degradation of the recycled slurry. For example, it was feared that valves might have to be cleaned or replaced once per day.

Actual operation shows a volumetric efficiency of 95 percent can be maintained for a period of four weeks between valve changes and up to eight weeks between seat changes. No valve cleaning is required. The usual reason valves must be changed is



Cross-section of gilsonite vein shows how hydraulic mining methods bring material to the surface. Above ground it is screened, crushed, desanded, and apportioned in the right concentration for pipe line shipment. Slurry is then pumped into the line by two 300-hp plunger pumps.

failure of the surface, with wire-drawing in small grooves. Seats fail in much the same way. However, this length of time between changes is so much better than was anticipated, and the cost of rebuilding so slight, that what was feared to be a major problem turned out to be no problem at all.

Solids Concentration. Pilot tests demonstrated that gilsonite slurries containing up to 40 percent solids by weight could be successfully handled. It is obvious that the line could be in serious trouble by injection of substantially higher concentrations. On the other hand, establishment of too low a concentration would waste water and power; both quite expensive in eastern Utah. Variations in concentration would reduce the throughput. A concentration of 35 percent was chosen for the design basis, and provision made in design of the slurry preparation plant to insure that the concentration could be tested before shipment.

Actual operation has occurred at concentrations as high as 42 percent. There are indications that the volumetric efficiency begins to fall off at about 41 percent, but this has not been fully explored. At 40 percent and below, there is no noticeable variation in either volumetric efficiency or pressure gradient with concentration.

No Erosion or Corrosion Problems. Unlike many mined ores, gilsonite will not abrade steel surfaces. It is completely insoluble in water and occurs naturally free of impurities. Practically no erosion or corrosion allowance has been provided in establishing wall thicknesses for the pipe line. The pipe line is designed to operate with a pipe wall stress of 65 percent of the yield strength. However, the minimum thickness is $^3/_{16}$ inch.

To be assured that metal loss would not be a problem, California Research Corporation, a subsidiary of Standard Oil Company of California, developed an interesting method of determining metal wall losses by using a small section of pipe in the test loop made radioactive in an atomic pile. By carefully measuring the minute amounts of radioactive iron worn away with the slurry, erosion rates were established in just a few hours of operation.

Even though gilsonite is not corrosive, a chemical inhibitor must be used because the presence of solids apparently tends to scour away any natural protective coating that otherwise might be formed by the corrosion products of water alone. Actual operation has shown no corrosion or erosion.

Pressure Control Practices. Bonanza is at an elevation of 5,700 feet; the summit, Baxter Pass is at 8,500 feet; the refinery west of Grand Junction is at 4,500 feet. It was believed prudent to keep the line "packed," or under pressure, for its entire length. Since the average ground gradient from Baxter Pass to the refinery is much steeper than the hydraulic gradient, substantial throttling is required at the refinery.

For 350 gpm, an incoming pressure of 1,200 psi is maintained by running the slurry through a 1½-inch diameter choke tube, followed by an angle-type throttling valve for minor adjustments. This results in a 75 psi pressure at Baxter Pass and 2,150 psi at Bonanza.

Freezing Precautions. The pipe line has been installed with 3½ feet of cover to prevent freezing. However, there are two exposed 800-foot long suspension bridges over canyons. These are insulated to protect them from freezing for a 24-hour shutdown. Beyond that time, they would be drained.

Attrition of Particle Size. It was impossible to predict the actual attrition of particle size from the test work, since the influence of the pump could not be separated from that of line friction. Slurry was pumped around the 500-foot test loop over 700 times to simulate the 72-mile trip

through the line. Attrition observed in the testing was, of course, anticipated to be greater than that of the full-scale line, where the pump would make only one pass at the slurry. Therefore, the filter design was conservatively based on the test loop attrition.

Actual operation shows little attrition. The slight increase in minus 200 mesh particles probably occurs largely in the back pressure control system.

Solids Recovery. An extensive investigation was made into possible methods of recovering the gilsonite solids from the pipe line effluent. For this application, vacuum filtration was selected since solids recovery was found by test to be virtually complete with no subsequent cleanup of water required. A moist cake containing 20 percent water was predicted due to the presence of very fine micron-sized particles resulting from degradation in the pipe line. Ultimately all water must be removed prior to melting. This is done in one operation by contacting the wet filter cake with 450° F. oil.

Actual operation of the filter plant has been very successful. The pipe line filtrate water has no gilsonite in it; it is actually used elsewhere in the refinery as industrial water. Filter cake moistures of 14 percent-18 percent are obtained, well within the capacity of the subsequent melting operation.

Continuity of Flow. The pipe line is designed for continuous flow and will only be shut down after all slurry is flushed from the system with water. Three electric-driven slurry pumps have been provided at the pump station, any two can maintain the established minimum flow. This allows one unit to be down for maintenance.

In the event of a power outage, a diesel-driven water pump, capable of flushing the system with water at the required flow rate, will be automatically cut into the pipe line. Except for this emergency condition, this pump normally provides high pressure water for ore cutting in the mine. As a final protection against shutting down with slurry in the system, a water reservoir capable of automatically flushing the entire line has been provided at the high point in the system. Fortunately, the reservoir is high enough to maintain the required flow velocity by gravity simultaneously in both directions until the system is entirely clear of slurry. It is also possible to make use of a high-pressure water pump installed in one of the processing plants at the refinery for back-flushing the line. These precautions were provided as worthwhile insurance against any possibility of plugging.

Pilot tests showed that if adequate velocities were maintained, slurry could be continuously circulated through the system without build up of solids or other evidence of malfunction. The test loop could frequently be shut down with slurry remaining in the pipe and restarted again. However, occasionally it plugged. Therefore, it was considered mandatory to provide for continuous operation. Fortunately, it was possible to provide this at nominal expense.

It has been necessary to flush the line from Baxter Pass for up to one hour several times due to equipment failures at one end of the line or the other. It is certain that the cost of the reservoir has already been paid out by avoidance of plugs by settled solids.

Pump Station and Slurry Preparation Plant. Gilsonite is pumped from the mine whenever mining is being done. It arrives above-ground at the slurry preparation plant where it is screened, crushed, desanded and a portion mixed to the right concentration for pipe line shipment. The remainder is stockpiled to provide continuous pipe line feed when the mine is not operating.

Cleaned, proportioned slurry is pumped into the pipe line by the two operating 300-hp plunger pumps. There is no intermediate booster station. Throughput could be doubled by construction of a booster station.

Operating Expenses. The operating expense can be broken down into two categories: that which is proportional to distance, and that which is not. Current out-of-pocket expense (excluding depreciation and prorated general administrative costs) per ton is shown in following table:

ITEM	Cost/ Ton	Cost/ Ton Mile
a. Not proportional to distance		
Slurry preparation	$0.43	$0.0060
Dewatering at Refinery*	0.40	0.0056
Sub total	$0.83	$0.0116
b. Proportional to distance		
Pump Station	$0.79	$0.0110
Pipe Line	0.14	0.0019
Sub total	$0.93	$0.0129
Grand total	$1.76	$0.0245

* After credit for water supplied to refinery.
Note: 1. Cost based on first few months operation.
2. Costs can be decreased by higher throughput, improved efficiency, and increased operating factor.

Future Prospects. The gilsonite line is one of the first major cross-country solids handling pipe lines now in operation. There exists a much greater potential for this means of transport, particularly where large tonnages are to be handled, or where other means of transportation are impractical or too costly. Each case will require very careful analysis of the many factors to be considered.

Factors controlling the design of the gilsonite line were few, and fortunately adequate safety factors could be provided for all those not completely defined in the pilot test. To design for other solids might require an entirely different approach. Although the experience gained is restricted to a unique material of low specific gravity, an important contribution has been made to the science of solids transportation by pipe line.

ACKNOWLEDGMENT
Presented at the Annual Pipe Line Conference of the API Division of Transportation, New Orleans, March 31-April 2, 1958 under the title of "Design and Initial Operation of the Gilsonite Slurry Pipe Line."

About the Author

John H. Henderson, Jr., chief engineer for operations, American Gilsonite Company, has been active in the design and engineering in all phases of the slurry pipe line. Initial work was in the direct design and construction for the mine development program, slurry preparation plant, and pumping station. Later responsibilities included startup and initial operation of the line, and present duties involve the engineering, operation, and maintenance of both the pipe line and the refinery located near Grand Junction, Colo. Henderson received a B.S. degree in mechanical engineering from the University of California in 1942. During service with the U. S. Navy from 1942 until 1947, he also did a year of graduate work at the University of Michigan. Joining Standard Oil of California, his assignments included design engineer, project engineer and project supervisor.

Cost Analysis in Pipe Line Design

Many engineering factors influence the most economical system. Taxes, earning power of investment, future costs and depreciation need to be considered, too.

By Dave Vondy, Constructive Engineering Company
New Orleans

CAREFUL EXAMINATION of many economic factors are essential before making the large investments required in building a new pipe line system. Quite often the ultimate operating conditions and capacity of a pipe line are not known at the time of design. However, the more operating information made available for analysis of particular conditions the better will be the economic design solution in the long run.

In economic studies it is well to consider the effects of these factors:

- Anticipated conditions (initial, ultimate, maximum, variations and operating flexibility needed).
- Costs (initial investment, future investments and operating).
- Financing (expected return on investment, income taxes, depreciation, whether money is tight or not).
- Useful correlations between primary variables.

Investigation of the relationships between these primary variables will yield the most economic solution.

Present Value of Costs. One of the most revealing methods of comparing the merits of alternate systems makes use of the present value of all initial and future costs. If one method of operation or installation has a lower total present value than an alternate, then it is the more economical. Such factors as income taxes and required return on investment have a significant effect on present values and therefore must be considered.

If an expression can be written for the present value in terms of the primary variables, the first derivative of this present value with respect to the variable in question can be set equal to zero; solution of the resulting equation gives the value of the variable for the most economical design.

Care must be taken in complex problems to insure that the result obtained is a true minimum of the present value and not a maximum or an extraneous solution. Often it is practical simply to determine the present values of the costs which vary and make a direct comparison of alternate systems or methods of operation.

Consider Money Earning Power. If the initial cost was $10 and $1 would be required yearly for the next 20 years, the present value would be $30 if money had no earning power. If money had an earning power (expected return) of 10 percent, then the $1 spent yearly would have a lower present value because a smaller amount of money than $20 available now would provide the required $1 yearly since it would be earning a return (or should be). Using discount tables, the total present value would be be $10 + $1(8.51) = $18.51.

Income Tax Savings. The effect of income taxes is significant too; present values must be placed on the same basis. Usually money invested is on hand after taxes have been paid while operating costs are deductible and therefore reduce income taxes. If company income taxes average 50 percent and future expense is a deductable operating cost, then the total present value for the above example in terms of money after taxes would be $10 + $1 (8.51) (1 — 0.5) = $14.25.

If straight line depreciation is used, then the present value of the saving in income taxes for 5 percent depreciation yearly (20 year period) would be $0.5 (8.51) (1 — 0.5) = $2.13 and the new total present value would be $14.25 — $2.13 = $12.12.

When credit is taken for depreciation a sufficiently high rate of return must be used to take into account the depreciated value of the facility. This loss in investment must be included in the return calculated. If a facility had an initial cost of $10 and no value after 20 years.

DEFINITION OF SYMBOLS

C_L	Pipe line cost ($/mile/inch diameter)
C_p	Equipment cost ($/shaft horsepower installed)
D	Pipe diameter inside (inches)
E_o	Fraction of the time operated
E_p	Fluid horsepower/shaft horsepower
G_d	Diesel cost (¢/gallon)
G_e	Total electric power cost (¢/kw-hour)
G_g	Gas fuel cost (¢/Mcf)
I	Initial investment ($)
L	Pipe line length (miles)
N	Number of stations
P	Line pressure (psia)
Q	Gas flow rate (Mcfd) or Liquid flow rate (gpm)
S	Yearly operating cost ($)
Σ	Present value ($)
d	Total differential
f	Cumulative discount factor at expected return
g	Depreciation rate, fraction
t	Income tax rate fraction
ρ	Density (pounds/cubic feet)
s	Subscript referring to station
Δ	Difference
$\cong$	Very nearly equal to
S_e	Yearly operating cost for electric power ($ per hp-year)
S_d	Yearly operating cost for diesel fuel ($ per hp-year)
S_g	Yearly operating cost for gas used for power ($ per hp-year)

considering income taxes 50 percent and 5 percent depreciation yearly, savings in incomes taxes for 20 years would be $5. For a required return of 10 percent, the present value would be $2.13 as shown above; but the value at the end of 20 years would be $14.20 as calculated from discount tables. Thus the money saved due to reduced taxes would be more than adequate to return the initial investment if this saving were earning 10 percent.

Depreciation Effect. Earning power of money to be used in any analysis is a function of depeciation and income taxes. It is usually considered by a company to depend upon the type of investment, particularly its risk or uncertainties. When a project has a quick write-off, the effect should be taken into account. There are a number of fixed operating costs such as insurance and property taxes which are assumed to be covered by the required rate of return or else are insignificant. Also there may be special financial conditions to be considered such as limited return, borrowed money, or even over-all operating loss.

As used herein, the present value of all future costs will be written:

$$\Sigma = I\,[1 - f\,(1 - t)g] + S\,[f\,(1 - t)]$$

which neglects future investment other than operating costs and should be revised if there were to be appreciable future investment. For the typical values used in examples, income taxes 50 percent, depreciation 5 percent yearly, life 20 years, money worth (discount value) 10 percent then the expression becomes:

$$\Sigma = I\,[1 - 8.51\,(1 - 0.5)\,0.05] + S\,[8.51\,(1 - 0.5)]$$

$$\Sigma = 0.788\,I + 4.25\,S$$

Fixed Installation Costs. There are a number of variables in the cost of a pipe line. For example, a major river crossing will be even more expensive than laying pipe in open water. Cost of a relatively short line will be high due to the fixed costs of a laying spread. Typical costs shown in Table 1 may generally be used for analysis.

TABLE 1

TYPE OF CONSTRUCTION	INSTALLED COST, C_i ($/MILE/IN DIAMETER)
Accessible dry land, std pipe	3,000
xhy pipe	4,000
Marsh or shallow water	6,000
Open sea water	10,000

Offshore costs are subject to considerable variation, primarily due to weather conditions. It is not unusual during the winter months for a spread to be forced to standby 80 percent of the time in an open Gulf operation.

Station costs excluding prime movers and pumping equipment are a function of fixed costs which vary considerably. For example, a cooling water supply may be required, a camp for operating personnel may be necessary and the cost of site improvement varies considerably between locations. It is necessary to use cost estimates for the particular situation met.

Station Site Economics. There is no general rule as to whether land should be purchased or rented. Figure 1 illustrates breakeven as a function of the primary variables of purchase cost, rent and required return on an investment. It was assumed that income taxes are 50 percent,

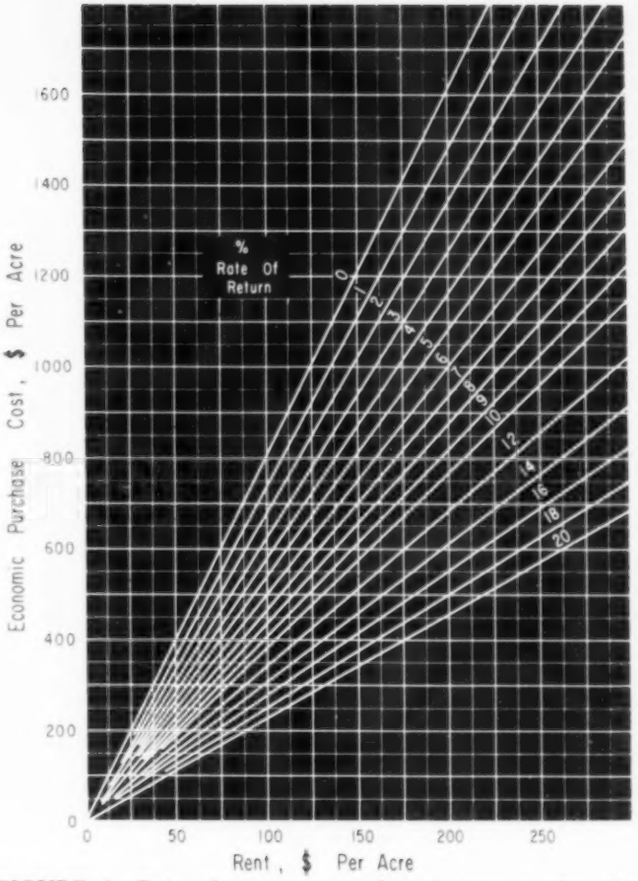


FIGURE 1—Rate of return comparison between station site rental and economic purchase costs.

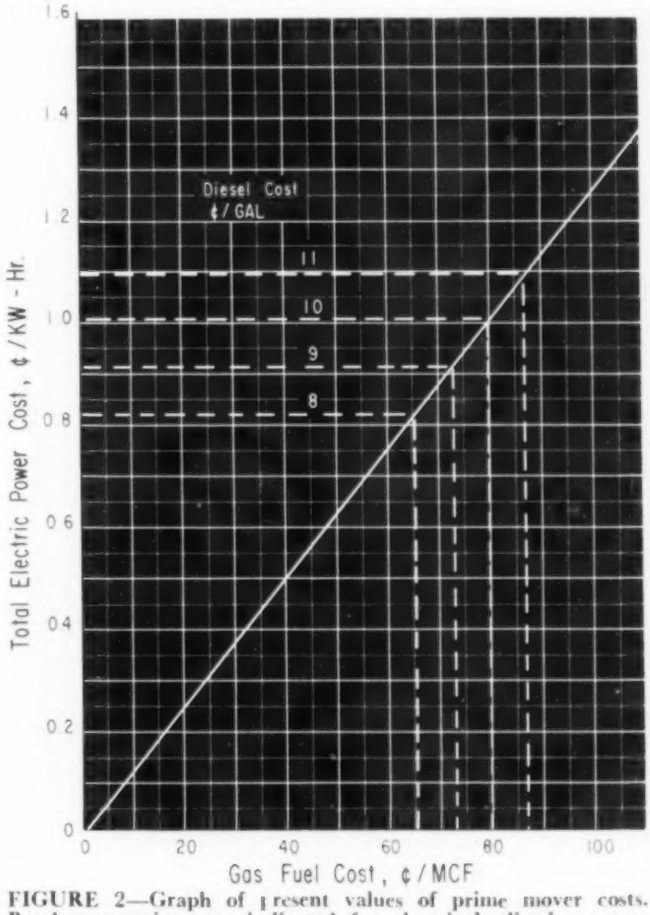


FIGURE 2—Graph of present values of prime mover costs. Break-even points are indicated for electrical, diesel, or gas-driven units.

no depreciation, 20 year life and property taxes 2.5 percent of actual value. For example, breakeven at a required return of 10 percent:

$$\Sigma = 1.106\ I = 4.25\ S;\ I = 3.84\ S$$

Longer life would not have much effect except at the lower rates of return.

From Figure 1 the rate of return which would be realized if a site were purchased rather than rented can be found knowing cost and rent; it is not unusual to find the rate less than zero. It may be concluded, generally, that it is more economical to rent land than to purchase a site. However, it may be desirable to purchase to enable full control and insure long life.

Generally property value increases; this may be a deciding factor in a marginal situation and usually requires that a relatively low rate of return be used in an analysis. If the site cost is comparatively low in relation to the total investment or to the cost of improvement, site purchase may be the most desirable.

Installed Equipment Costs. It is difficult to generalize about installed equipment costs. When the results of a problem are significantly influenced by differences in installed costs, specific cost estimates should be made. For large gas engine driven compressors, the installed cost is nearly proportional to the installed horsepower, but it is increased by increase in pressure and by more than one stage of compression. Specific cost increases with decrease in size for smaller units. To determine the most economical type of compressor, accurate costs are necessary.

Where some equipment cost is proportional to the horsepower, the installation cost may decrease considerably with increase in size. Pump costs vary with type of pump, operating pressure and size. The ratio of fluid horsepower to shaft horsepower varies considerably between equipment, typical values being 0.80 for large gas compressors and 0.70 for well-selected pumps. Engines usually consume around 8 percent of the brake horsepower for accessories. Table 2 shows typical equipment costs:

TABLE 2

Equipment	Equipment Cost ($/Shaft HP)	Installed Cost ($/Shaft HP)
Gas engine driven reciprocating compressors		
Packaged, 1000 psi, single stage		
150 shaft HP	260	...
300 shaft HP	200	...
600 shaft HP	170	...
Packaged, 1000 psi, three stage		
150 shaft HP	300	...
300 shaft HP	230	...
600 shaft HP	190	...
Packaged, 10,000 psi, single stage		
600 shaft HP	220	...
Large Units	...	250
Pumps without driver (Δp = pressure)		
Low pressure centrifugal (extremely variable)	...	130
500 psi centrifugal	...	70
500–1500 psi reciprocating, double action	...	100
Gas engines	...	50
Diesel engines	...	65
Large electric motors with accessories	...	35

Operating Costs; Stations and Lines. Operating cost of a station can best be broken down into fixed costs, relatively independent of the facilities, and variable costs which are for the most part proportional to the installed horsepower. Thus fixed costs might include operating personnel, site maintenance and fixed utilities.

Operating personnel cost around $7500 per year per man including turnover, benefits and overhead for a full time operating crew of 3½ men excluding relief.

Line Maintenance. Maintenance costs for pipe lines vary considerably. If adequate preventative measures are taken including external coating, cathodic protection and inhibiting of internal corrosion, maintenance is reduced to routine inspection plus an occasional repair.

The larger and longer the line, the higher the maintenance cost, and the more investment which can be justified in preventative measures. For purposes of analysis it can generally be assumed that the difference in maintenance cost between two lines having nearly the same diameter is insignificant and that maintenance cost varies directly as the pipe line length.

Prime Mover Comparisons. Maintenance costs for engines and the equipment driven runs around $4 per year per horsepower.

Total cost of electric power varies from 1.5 cents/kw-hour for small remote stations to less than 0.5 cents/kw-hour at plants where consumption is high. For a pump installation assuming 0.85 kw/shaft horsepower and 360-day year electric power costs could be expressed as:

$$S_e = 24\ (360)\left[G_e \frac{0.85}{100}\right]\frac{E_o}{E_p}$$

$$S_e = 73.3\ G_e \frac{E_o}{E_p}$$

and for the special case $E_o/E_p = 1.0$:

$$S_e = 73.3\ G_e$$

For a diesel engine installation, consumption is usually near 0.065 gallons/hp-hour and fuel costs around 10 cents/gallon. Lubricating oil costs around 0.04 cents/hp-hour. For a pump installation and a 360-day year:

$$S_d = 24\ (360)\left[\frac{0.065\ G_d + 0.04}{100}\right]\frac{E_o}{E_p}$$

$$S_d = 59.6\frac{E_o}{E_p}$$

and for the special case where $E_o/E_p = 1.0$:

$$S_d = 59.6$$

Gas engines require around 8,500 Btu/horsepower, natural gas heat of combustion is usually near 1,000 Btu/scf (lower heating value), and lubricating costs are around 0.04 cent hp-hour. For a gas driven pump installation operating a 360-day year:

$$S_g = 24\ (360)\left[\left(\frac{8500}{1000}\right)\left(\frac{G_g}{100}\right)\left(\frac{1}{1000}\right) + 0.0004\right]\frac{E_o}{E_p}$$

$$S_g = (0.733\ G_g + 3.5)\frac{E_o}{E_p}$$

and for the special case where $E_o/E_p = 1.0$:

$$S_g = 0.733\ G_g + 3.5$$

The above calculations may also be made when operation is full time and shaft horsepower is used.

Economic Power Source. In a particular situation it is estimated that engines will have a yearly maintenance cost of $4/horsepower more than would electric facilities and that the engines will cost $5/horsepower more yearly for operating personnel. Installed costs per horsepower will be used as shown in the table. For income taxes 50 percent, depreciation 5 percent, life 20 years, and required

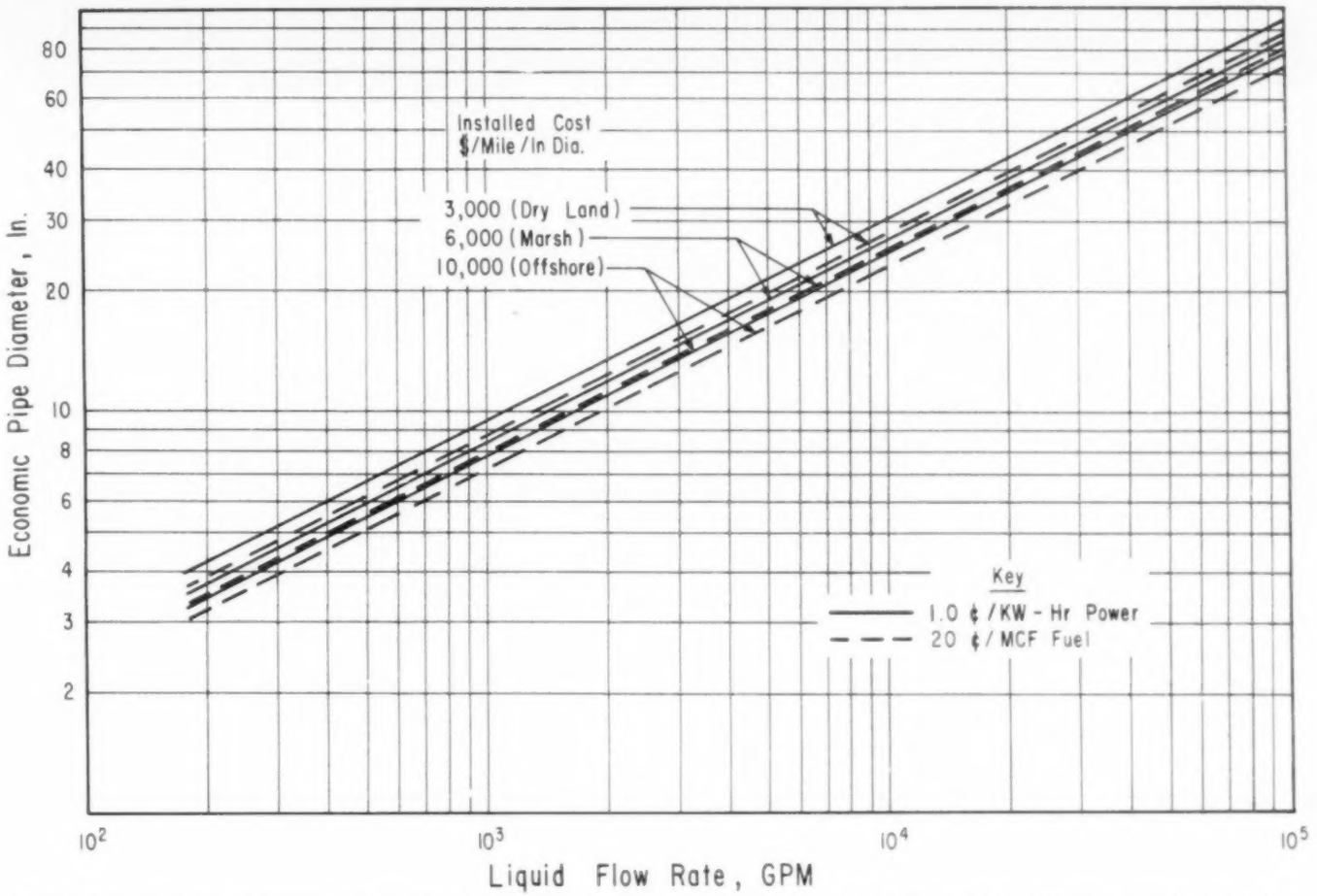


FIGURE 3—Plot of the economic diameter for liquid pipe lines on representative laying costs under different terrain conditions.

return 10 percent, the following present values per horsepower are calculated:

Electrical,

$$\Sigma_e = 35\,[1 - 8.51\,(0.05)] + 73.3\,G_e\,[(8.51)\,(0.05)]$$
$$\Sigma_e = 27.6 + 312\,G_e$$

Diesel,

$$\Sigma_d = 0.788\,(65) + 4.25\,(59.6 + 9)$$
$$\Sigma_d = 342$$

Gas,

$$\Sigma_g = 0.788\,(50) + 4.25\,[(0.733G_g + 3.5) + 9]$$
$$\Sigma_g = 92 + 3.12\,G_g$$

Figure 2 is a plot of the equal present values indicating the breakeven points.

Sizing Liquid Pipe Lines. It is often desired to determine what size pipe should be used for transporting liquids. Two situations will be considered, electric power at a cost of 1 cent/kw-hour and natural gas at a cost of 20 cents/Mcf. Assuming that income taxes are 50 percent, depreciation 5 percent, life 20 years, money is worth 10 percent, differences in specific pump with driver costs are negligible compared to differences in pipe line costs, operating costs are constant, and operating time/pump efficiency = 1.0, then for electric power:

$$\text{Fluid horsepower} = \frac{\Delta P Q}{1715}$$

$$\Delta P \cong 0.0227\,LQ^2\rho/D^5$$

$$\Sigma = 0.788\left[C_L DL + NI_s + \frac{C_P LQ^2\rho\left(\frac{0.0227}{1715}\right)}{D^5 E_P}\right] + 4.25\left[\left(\frac{0.0227}{1715}\right)\left(\frac{LQ^2\rho}{D^5}\right)(73.3) + NS_s\right]$$

$$\frac{1}{L}\frac{d\Sigma}{dD} = 0.788\,C_L + \left[1.04\,(10^{-5})\left(\frac{C_P LQ^2\rho}{E_P}\right) + 0.00412\,LQ^2\rho\right]\left[-5D^{-6}\right] = 0$$

Assuming a density of 55 pounds/cubic foot and C_p/E_p for electric facilities of 200,

$$D = \frac{1.14Q^{\frac{2}{9}}}{C_L^{\frac{1}{9}}}$$

And similarly using $C_p/E_p = 220$ for gas facilities,

$$D = \frac{1.047Q^{\frac{2}{9}}}{C_L^{\frac{1}{9}}}$$

Results from these equations are plotted in Figure 3. Such factors as the liquid density, pump efficiency and

ERRATA

The following corrections should be made in "Pulsations and Gas Measurement" by Howard S. Bean, February, 1958, PIPE LINE INDUSTRY, Addenda Page 44.

The definition of Z in the HODGSON number should read:

$$Z = v_c p_c$$

In the second expression of the HODGSON number omit the line:

p_c is the instantaneous pressure at the meter inlet

Add the following:

$\bar{p}$ is the average pressure in the receiver

Also in the Addenda omit:

While $\bar{p}_c$ and $\bar{p}$ are time average values,

Expression for the STROUHAL number should read:

$$N_s = \frac{Df}{\bar{V}}$$

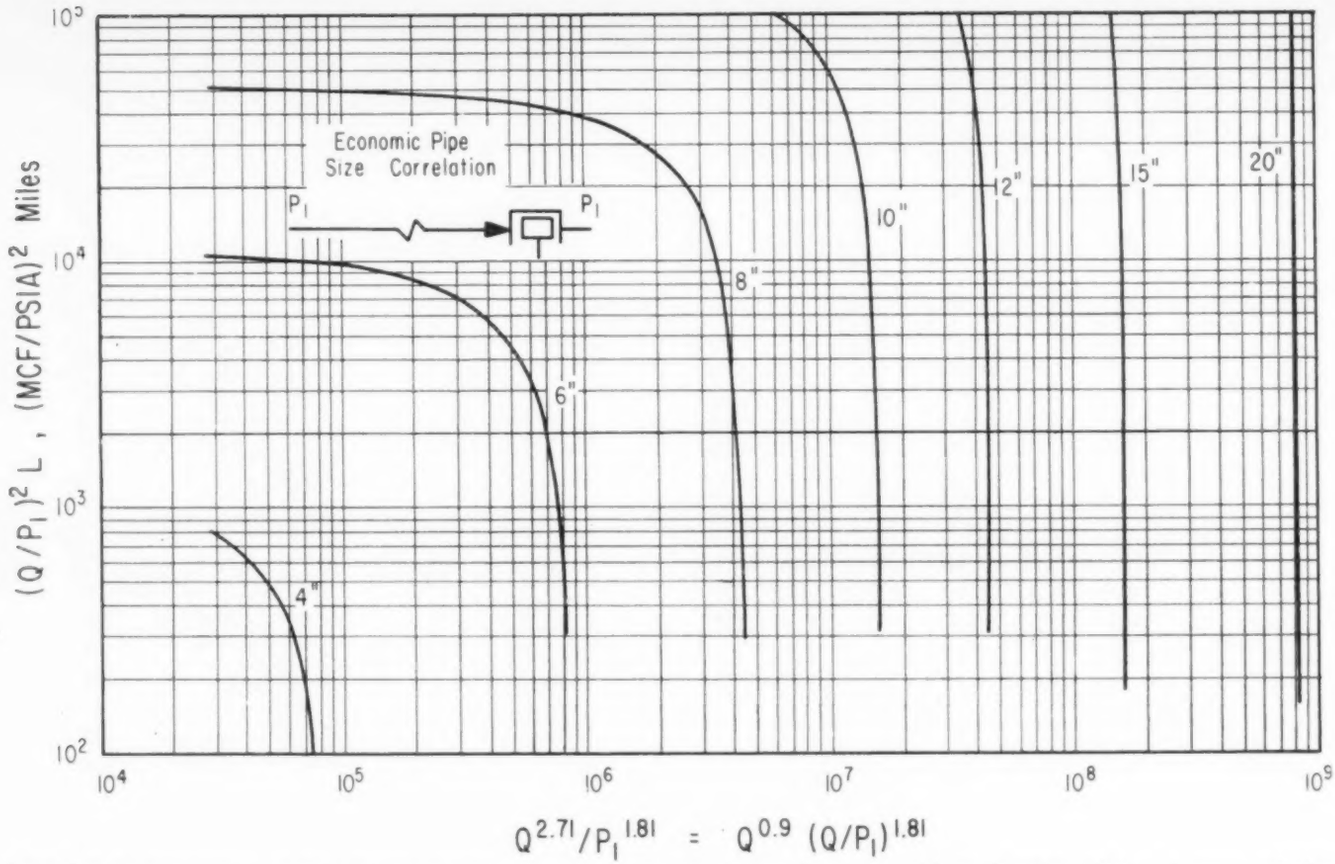


FIGURE 4—Correlation of flow factors provides estimate of economic gas line size without lengthy trial and error solution.

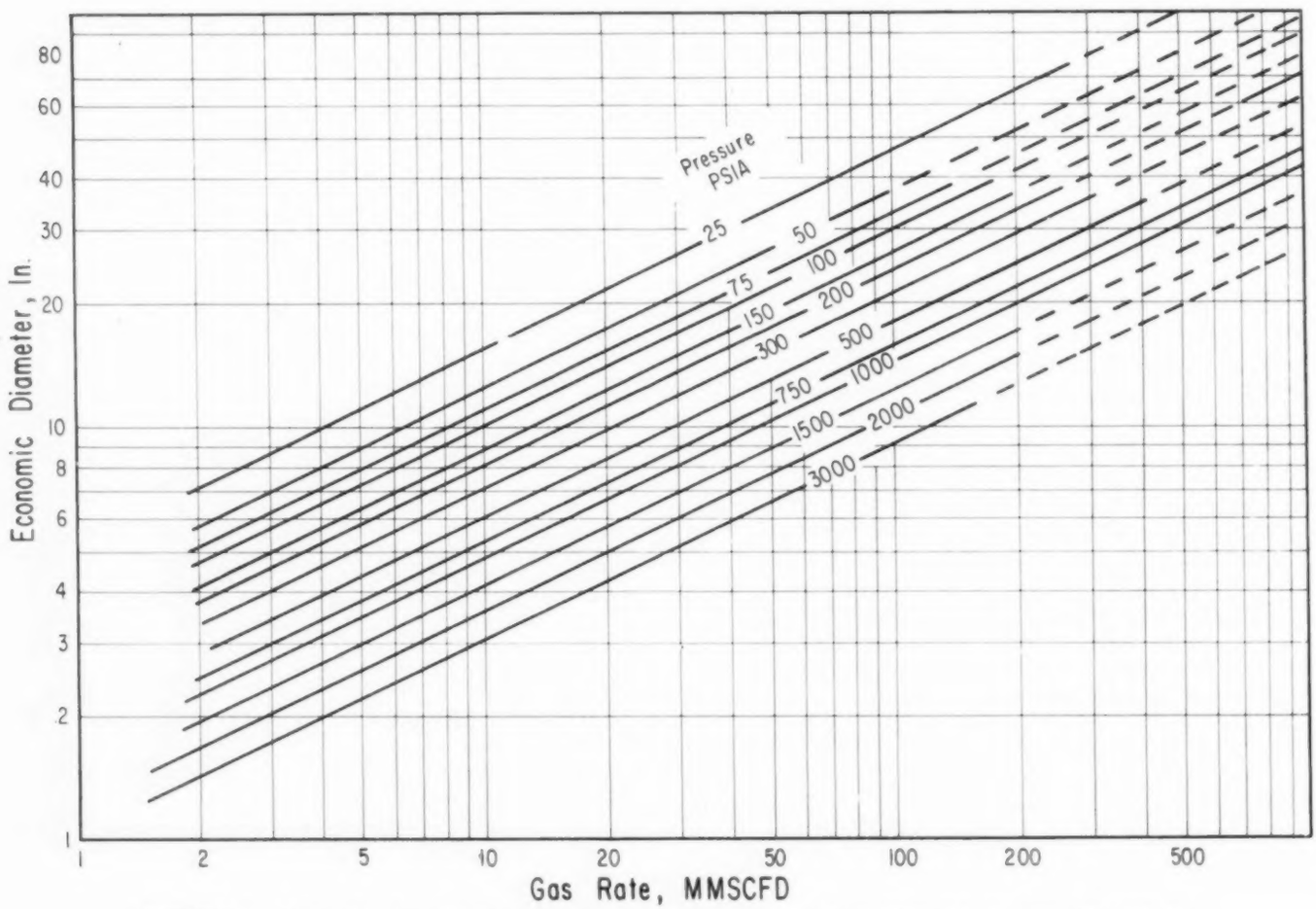


FIGURE 5—Economic pipe diameter for short gas lines at various flow rates and pressure differentials.

the installed cost of the equipment are raised to such a low power that small variations will have little effect. However, the cumulative effect of several different values could be significant. As shown in Figure 3, when installation costs are high, smaller pipe with higher related operating costs is justified. It is further illustrated that when power costs are high, larger diameter pipe having a higher installed cost is justified.

Economic Size of Gas Pipe Lines. Consider natural gas available at pressure P_1 which is to be delivered at this same pressure to some point L miles away; a single one stage compressor station is to be installed at the delivery point. Financial factors will be used as before, and the following values will be substituted into the equation: C_L = \$3,000/mile/in diameter, C_p = \$250/hp, E_p = 0.80, G_g = 20/Mcf. Neglecting common costs:

$$\text{Shaft horsepower} \cong 0.277Q\left[\left(\frac{P_b}{P_a}\right)^{0.283} - 1\right]$$

For pressure drop, $P_1^2 - P_2^2 \cong 1.31\,Q^2L/D^{5.24}$

$$HP = 0.277Q\left\{\left[\frac{P_1}{\left(P_1^2 - \frac{1.31\,Q^2L}{D^{5.24}}\right)^{\frac{1}{2}}}\right]^{0.283} - 1\right\}$$

$$\Sigma = 0.788C_LDL + 0.277Q\,[C_p\,(0.788) + 4.25\,(0.733G_g + 3.5)]$$
$$\left\{\left[\frac{P_1^2}{P_1^2 - \frac{1.31\,Q^2L}{D^{5.24}}}\right]^{10.5} - 1\right\}$$

$$\frac{d\Sigma}{dD} = 0.788C_LL - 0.207\,Q^2LP_1^{0.23}\,D^{-6.45}\,[0.788C_p + 3.12G_g + 15]$$
$$[P_1^2\,D^{5.24} - 1.31\,Q^2L]^{-1.105} = 0$$

$$D = \left[1.31\left(\frac{Q}{P_1}\right)^2 LD^{0.29} + 0.034\,Q^{2.71}/P^{1.81}\right]^{0.276}$$

This resulting equation is unwieldy to handle because solution requires trial and error. The plot in Figure 4 permits direct solution from known information. This equation and plot solve only problems for the conditions stated. It will not tell if the pipe line length is too great for a single compressor station nor will it give economic station spacings.

It is often desirable to know approximately the economic diameter for quite short line as in plant design. Figure 5 is a plot of the above equation neglecting the expression containing L. Also higher installation costs were considered for elevated pressures. Smaller diameter pipe would ordinarily be used when loss in pressure does not have to be made up by compression.

Economic Station Spacing. This method in the above examples can be used to determine economic spacing of pump or compressor stations if costs can be written as a function of primary variables. Variation in operating costs with change in the primary variables must be known fairly accurately. Where the cost of a given length line of particular diameter is fixed; the horespower input to a liquid line of fixed diameter and length is fixed; these costs may not enter the calculation. However, the economic diameter may be considerably larger where fewer pump stations are required for a larger pipe diameter.

It is ordinary practice to install fewer stations than will be required eventually when the line capacity is to be increased with time. The importance of deferring initial investment to reduce present value is significant in such a situation.

Deferred Investment Offshore. A typical example of deferred investment may be made for an offshore line.

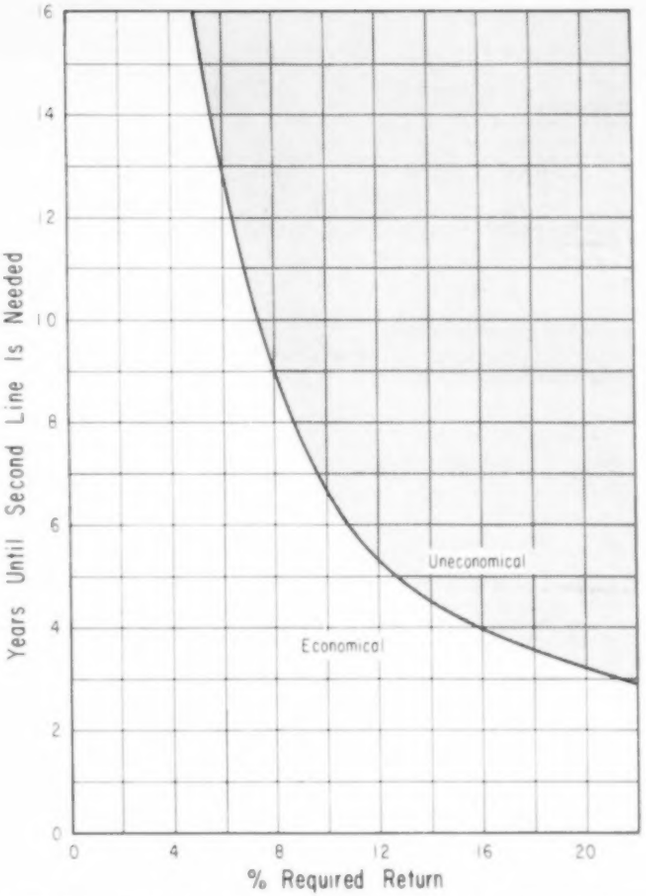


FIGURE 6—Graph shows when it might be economical to lay a second line for future demand at the same time an inital one is laid offshore.

For a particular offshore installation it is estimated that the installed cost of two lines laid at the same time would be 80 percent of the cost of two lines laid separately. It is desired to determine when it is economical to lay two lines initially, considering that the second line will not be needed for several years. Neglecting the cost of the first line in the present value:

$$\Sigma = I_1\,[1 - f\,(1 - t)g] = I_2\,\Delta f \qquad \Delta f = 0.60\,[1 - 0.025f]$$

Results obtained from this equation and discount tables are plotted in Figure 6. Before the investment can be justified, need for the second line must be assured.

—The End

About the Author

Dave Vondy, shown here setting up plant model, has a varied background in engineering design. His experience includes work as a senior production engineer with Continental Oil Company in offshore operations, design engineer with Delta Tank Manufacturing Company and with Black, Sivalls & Bryson, plus process engineering with Midwestern Constructors and Tuloma Builders. Vondy received a mechanical engineering degree from the University of Colorado. He is active in engineering and professional societies, including API, AIME, ASME and the Louisiana Engineer Society.

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

These practical aids give quick, reasonably accurate answers to design, maintenance and cost estimating problems. PIPE LINE INDUSTRY will pay $25 for each chart, nomograph or data sheet published—$15 for each Rule of Thumb. Send your ideas to PIPE LINE INDUSTRY, P. O. Box 2608, Houston, Texas

Engineering Design —43—Use Nomograph to Find Tank Capacity

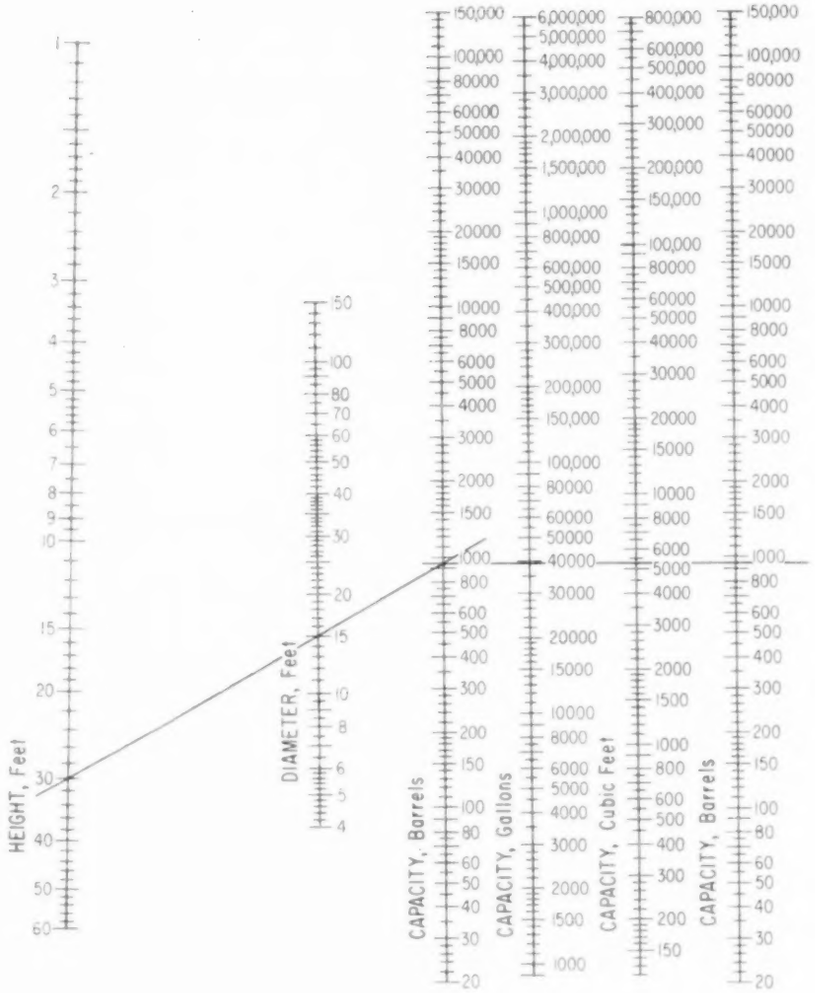
This simple nomograph can be used to find the capacity of your vertical cylindrical tanks. Here's how it works:

Draw a straight line from the "height" scale through the "diameter" scale and to the first "capacity, barrels" scale. Read directly the capacity of the tank in barrels. (Note: The "height" scale may be used to indicate the over-all height of the tank or the depth of liquid in the tank.)

Draw a second straight line connecting the two "capacity, barrels" scales at the same reading on each scale. Read the capacity of the tank in gallons and cubic feet on the proper scales.

The nomograph was constructed as follows:

1. The "height" scale is based on two log cycles per ten inches with a range of 1 to 60 feet.
2. The "capacity, barrels" scale is based on four log cycles per ten inches with a range of 20 to 150,000 barrels.
3. The "diameter" scale is based on three log cycles per ten inches with a range of 4 to 150 feet.
4. The distance between the height and diameter scales is exactly two-thirds the distance between the height and "capacity, barrels" scale.
5. Determine points to locate the diameter scale from the following equation: Capacity, barrels $= 0.1399\ (\text{diameter})^2\ (\text{height})$, units in feet.
6. The "capacity, gallons" scale is based on four log cycles per ten inches. The initial point on the scale is determined as follows: 20 barrels x 42 gallons per barrel — 840 gallons. The range of the scale is 900 to 6 million gal.
7. The "capacity, cubic feet" scale is based on four log cycles per ten inches. The initial point on the scale is determined as follows: 20 barrels x 5.6146 cubic feet per barrel = 112.292 cubic feet. The range of the scale is 120 to 800,000 cubic feet.

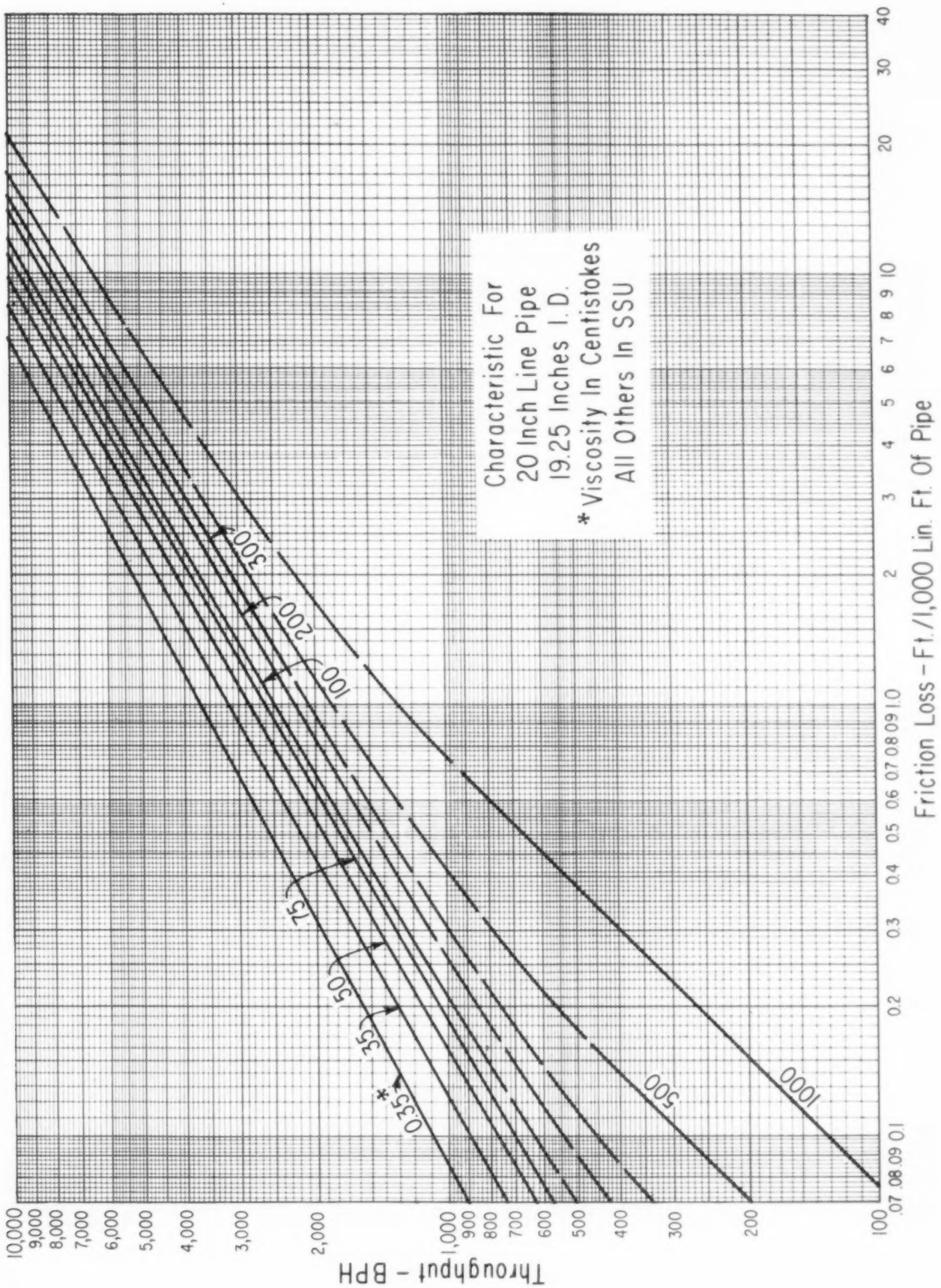


Engineering Design —44—Head Loss Charts for Various Sizes of Pipe

Friction Loss Characteristics for 20-inch pipe were computed by a pipe line company using data of the Hydraulic Institute. Use of these data in laminar and critical zones is adequate for estimates. Friction losses in transition and complete turbulent zones are very accurate.

(Chart 9 in a series of 19—20-inch line pipe)

ENGINEERING DESIGN 44



The Gulf Printing Company's recently completed addition added 93,000 square feet to office and printing areas. The new brown and buff tile building provides more than three acres of working space—the largest plant of its kind in the Southwest. By streamlining operations, the new plant makes it possible to speed up and improve service to Gulf Publishing subscribers.

$1 Million Investment in the Future

. . . Expanding Gulf Publishing and Gulf Printing companies move into larger quarters . . .

PUBLISHING COMPANIES grow in direct proportion to the service they provide. And subscriber acceptance is the yardstick used to measure their success.

Since you, the subscriber, have been the key factor in Gulf Publishing's growth for 41 years, it is only proper that we share with you on these pages outstanding examples of the progress your acceptance has created. First of all, you have been directly responsible for the rapid circulation growth of WORLD OIL, PETROLEUM REFINER and PIPE LINE INDUSTRY magazines. During the past five years, Gulf's subscription lists have increased 52.8 percent —from 33,500 to more than 51,000— the largest circulation of any oil industry publisher.

This indication of reader acceptance has made it possible for our three industrial publications to increase total advertising by 1,317 pages during the same period—the biggest increase of any publisher serving the oil industry. Last year, Gulf Publishing advertising sales set a new record— 6,125 pages.

What's more, Gulf's bound equipment catalog files have greatly improved their service to those who buy and specify equipment and services. Since 1952, distribution of the composite catalogs serving drilling, production, pipe line and refining phases of the industry has increased 59 percent—from 17,130 to 27,212 recipients.

For these reasons—all examples of your faith in us—Gulf Publishing Company and Gulf Printing Company have made the following investments in the future:

Largest printing plant in the Southwest. More than 93,000 square feet of working area has just been added to the Gulf Printing plant in Houston at a cost of more than $950,000. The new, ultra-modern addition gives the plant a total of 135,000 square feet of office and printing facilities, the largest plant of its kind in the Southwest. More than 75,000 square feet of the new addition is air conditioned with a 400-ton central unit.

The added plant and office space has improved efficiency of publishing

Until the new printing plant addition was opened earlier this year, the Gulf Publishing building had been the home of most of the printing facilities as well as publishing since 1928. The publishing building's interior has been completely remodeled in recent months. New improvements include relocation of the entrance, installation of new elevator, expansion of the library, plus addition of 11,200 square feet of badly needed space for the fast-growing publishing departments.

Gulf Publishing's oil library was recently expanded and reorganized. A popular source of oil industry information, the library is available to all who wish to make use of this company service. At left, WORLD OIL Editor Don Kliewer; center, WORLD OIL and PIPE LINE INDUSTRY Editorial Director Warren Baker; far right, PETROLEUM REFINER Editor George Gibbs.

Each of the five two-color letterpresses shown above can print 16 multi-color PIPE LINE INDUSTRY pages at once. In addition, the plant has 11 small automatic letterpresses, 4 large one-color letterpresses, 3 small two-color letterpresses, 2 large two-color offset presses, 2 small one-color offset presses, and another large two-color letterpress.

Enlarged composing room working area, plus the addition of new equipment, have made it possible to speed up the printing of Gulf's industrial publications. More than $235,000 worth of new equipment has been installed since last November.

operations, thus increasing subscriber service to the maximum. All of the printing departments—sales, printing of telephone directories, printing of publications and catalogs, plate making, composing room and art department—are now under one roof at the West Dallas Street address.

$250,000 worth of new equipment. To improve speed and efficiency in the printing of Gulf's industrial publications, two new two-color presses and a one-color press have been added to the 23 letterpresses and three offset presses already in use.

New bindery, composing room and offset plate making equipment have been installed. And there is ample room left for future expansion.

Expanded publishing facilities. By moving the printing equipment to the new plant, much needed office space was added for the fast-growing publishing staff. In fact, 11,200 extra square feet were provided, for a total of 24,000 square feet of office space, an increase of 85 percent.

The publishing company entrance has been moved and remodeled. A new elevator has been added. The mailing room has been moved to larger quarters, greatly improving its efficiency.

The circulation, book, advertising and editorial departments are now working under one roof—in completely remodeled offices.

New, Modern Library. Customer use of Gulf Publishing library has increased so rapidly in recent years it is now being reorganized and enlarged. A new index system has been set up to improve customer service. And a large number of new oil publications is constantly being added.

Gulf's research facilities are available to all, readers and advertisers alike, who are seeking information about the oil industry.

GPC's operations also include publishing of technical petroleum books and oil industry stock forms. Further expansion of these departments is being planned.

These are but a few of our investments and plans for the future. Thus, by improving subscriber service, we hope to increase your acceptance of Gulf publications.

That will be the key to our future growth. **—The End**

During an inspection tour, Interstate's Roy Daugherty points out some of the actual field conditions that were reported and corrected at regular safety meetings. Old sump lids were replaced with heavy-duty rimmed covers fitted with float stick level indicators.

Rotating Inspections . . .

Make Every Man a Safety Director

Each month a new man makes the rounds of Interstate's field pump stations to check for potential safety hazards.

Reported valve leakage troubles were solved with proper maintenance and lubrication. Inspections improve operations as well as eliminate hazards.

ROTATING SAFETY inspection assignments among field personnel helps Interstate Oil Pipe Line Company keep a fresh slant on safety. For more than a year, inspections have been made immediately before monthly safety meetings in the Magnolia, Ark., district. Observations are reported and discussed at the meetings.

Inspections usually cover two or three fields. Pumping units, valves, headers, and controls in one or more areas are included in the rounds. Inspectors note any hazards found. Corrective measures are discussed at the meeting.

Interstate has found that rotating inspection assignments avoids placing the burden of being a critic on any one person. It brings a fresh viewpoint to the job each month. But more important, a man becomes more safety conscious after a tour as an inspector.

Many inspectors have provided maintenance ideas that improve operations as well as prevent accidents. The inspections also provide realistic situations for safety meeting topics. Among them have been: improving plug valve maintenance to cut down use of cheaters, covering pump sumps with heavy-duty lids fitted with float stick to indicate fluid level and prevent overflow, and bevelling pump unit concrete slabs for safer and easier maintenance.

The Magnolia district recently completed a full year without a lost-time injury as proof of the program's success. —**The End**

Special attention is given to operation of valves. Rotating inspections and follow-up maintenance have cut down on the need for "cheaters." Fresh outlook of a new inspector each month locates many operating faults that might otherwise be missed.

Another "hazard" eliminated. Concrete pump slabs were bevelled to prevent tripping and make equipment handling easier.

By Donald G. DePugh, PIPE LINE INDUSTRY Staff

Route of Midwestern's proposed gas line extending from Portland, Tenn., to Canada. Midwestern is seeking permission to build the Portland-to-Joliet section this year.

Midwestern Files Application With FPC Seeking Approval for 350-Mile Gas Line

Midwestern Gas Transmission Company has filed an application with the Federal Power Commission seeking permission to construct a 350-mile, 30-inch gas pipe line from Portland, Tenn., to Joliet, Ill.

This recent action separated for FPC consideration, the southern portion of a 1,112-mile line originally proposed to extend from Portland to a point near Emerson, Manitoba, where it would connect with the Trans-Canada gas line. Gas would be delivered to Midwestern's Southern section at Portland by Tennessee Gas Transmission Company.

The $45 million project will supply 260 Mmcf of gas daily to the Chicago-Gary area this winter. Compressor stations will be constructed near Portland and Jasonville, Ind.

The alternate plan followed a reported decision by Peoples Gas Light and Coke Co. to withdraw opposition to Midwestern's proposal to enter the Chicago-Gary area.

Another development, though, has delayed the project's approval. The Justice Department recently refused to give advance anti-trust immunity to the Peoples-Midwestern understanding pending outcome of an investigation by a Wisconsin federal grand jury.

George H. Perrine, chairman of the Illinois Commerce Commission, who arranged for the contesting parties to meet and agree on a plan to supply gas to the Chicago area, sees no anti-trust violations in the new plan. Peoples has allowed a competitor to enter the market and several distributing companies, including Peoples, will buy gas from Midwestern.

Peoples had protested Midwestern's application because a subsidiary of Peoples, Natural Gas Pipeline Company, had planned a 416-mile line from Beatrice, Neb., to Joliet, Ill., to deliver additional gas to the Chicago area. However, Natural Gas Pipeline Company was forced to postpone its project due to the Memphis decision.

Since Midwestern would be dealing with new customers, the Memphis decision would not affect it, and the company would be able to finance the new line. But Peoples concession is contingent upon two things: the Justice Department's ultimate approval and Midwestern's ability to succeed in completing the line before this winter.

Midwestern still proposes to construct the original $111 million project which it planned 2½ years ago. Its plans to import gas from Canada to serve markets in Minnesota, Wisconsin, Michigan and North Dakota were protested by American Natural Gas Company, Northern Natural gas Company and Peoples. Midwestern presently is awaiting the verdict of Canada's Borden Commission, which recently made a study of its natural gas reserves, on the request for exporting gas.

Plans call for importing 200 Mmcf of gas per day with an additional 200 Mmcf daily when and if possible. The line will have a capacity of 400 Mmcf of gas per day. In addition to the main line 648 miles of delivery extensions from 3 to 18 inches are planned.

Midwestern asked for FPC approval by April 15. "Otherwise it can't get the gas to the Chicago area this year, and its alternative project will be meaningless and will be dropped . . ."

Southern Natural Gas Co. Plans $40 Million Program

Southern Natural Gas Company has filed two applications with the Federal Power Commission seeking authorization for the construction and operation of natural gas pipe line facilities in southern Louisiana.

The main portion of the $40 million project would be 136 miles of 24 and 26-inch pipe for loops and main line extensions. About 215 miles of various diameter supply lines will be added along with 3,650 additional compressor horsepower to the White Castle and Toca station in Louisiana. Also 7.9 miles of 20-inch line loops; 660 compressor horsepower at its Franklinton station and 23 measuring stations will be constructed.

Southern Natural's gas system leading into the Pickens and Gwinville, Miss., station will have an increase in capacity amounting to about 298 Mmcf per day.

The FPC recently authorized Southern Natural to construct and operate 43.5 miles of various diameter laterals; 2,000 additional horsepower at its Toca compressor station; 660 hp at its Franklinton station; and measuring facilities. Cost of the construction is estimated at $4 million.

Southern Natural also filed an application requesting permission to construct about 12½ miles of pipe line and a measuring station to enable it to receive into its system gas produced in the Tantine field in Plaquemines Parish, La. Cost is nearly $1 million.

The proposed 10¾-inch pipe line would extend from a connection with the company's system on the west bank of the Mississippi River to the Tantine field.

Brown & Root Tug Tows Barge M-211

Brown & Root's tug M. P. Anderson prepares to tow the Barge M-211 from the Houston yard to Lake Maracaibo in Venezuela. Brown & Root is handling construction on a 40-inch gas pipe line for Creole Petroleum Company.

Brown & Root, Inc. to Construct 40-Inch Underwater Gas Pipe Line in Venezuela

Brown & Root soon will begin construction on the "largest pipe line ever projected in the entire history of the oil business"—an underwater gas system to be built for Creole Petroleum Company in Lake Maracaibo in Venezuela.

The Barge M-211, one of the largest pipe laying barges ever constructed, weighed anchor late last month carrying a cargo of equipment and materials exceeding 2 million pounds.

Creole's large diameter line includes more than 10 miles of 40-inch steel pipe. After being reinforced and concrete weight-coated, the pipe will have an over-all diameter of 52 inches. Each joint, which consists of about 40 feet of pipe, will weigh approximately 20 tons.

The gas gathering system will consist of 18 separate lines which amount to 10,153 feet of 16-inch pipe; 43,400 feet of 30-inch and 72,900 feet of 40-inch. The lines will be laid in 60 feet of water, and the system will serve the Tia Juana Conservation Plant No. 3.

Brown & Root will process the submarine pipe in yards on the east and west side of the lake, where over 3 million square feet of steel mesh and 23,000 cubic yards of concrete will be applied for reinforcement of the pipe.

Each line will have a vertical riser weighing up to 100,000 pounds, each of which will require extra heavy derrick equipment.

Brown & Root's M-211 is especially equipped for laying heavy pipe. The barge has five 40-ton capacity davits, which will be used for lowering-in the pipe. Eight 8,000-pound anchors and a 710-pound lowering pontoon were constructed by Brown & Root for this project. This large stringer was carried on the deck during the tow.

The barge was towed by Brown & Root's tug M. P. Anderson from the company's yards to Venezuela.

Gas Association to Celebrate Anniversary

The Southern Gas Association will celebrate its Golden anniversary at its convention April 28-30 in Dallas.

Tribute will be paid to the pioneers of the gas industry who held a meeting in Atlanta in 1908 to organize the association. With emphasis on the forward look, the Sales section will present top executives of four of the largest manufacturers of gas appliances and equipment. General sessions will present nationally known speakers, headed by Norman Vincent Peale. Convention headquarters will be in the Statler Hilton Hotel.

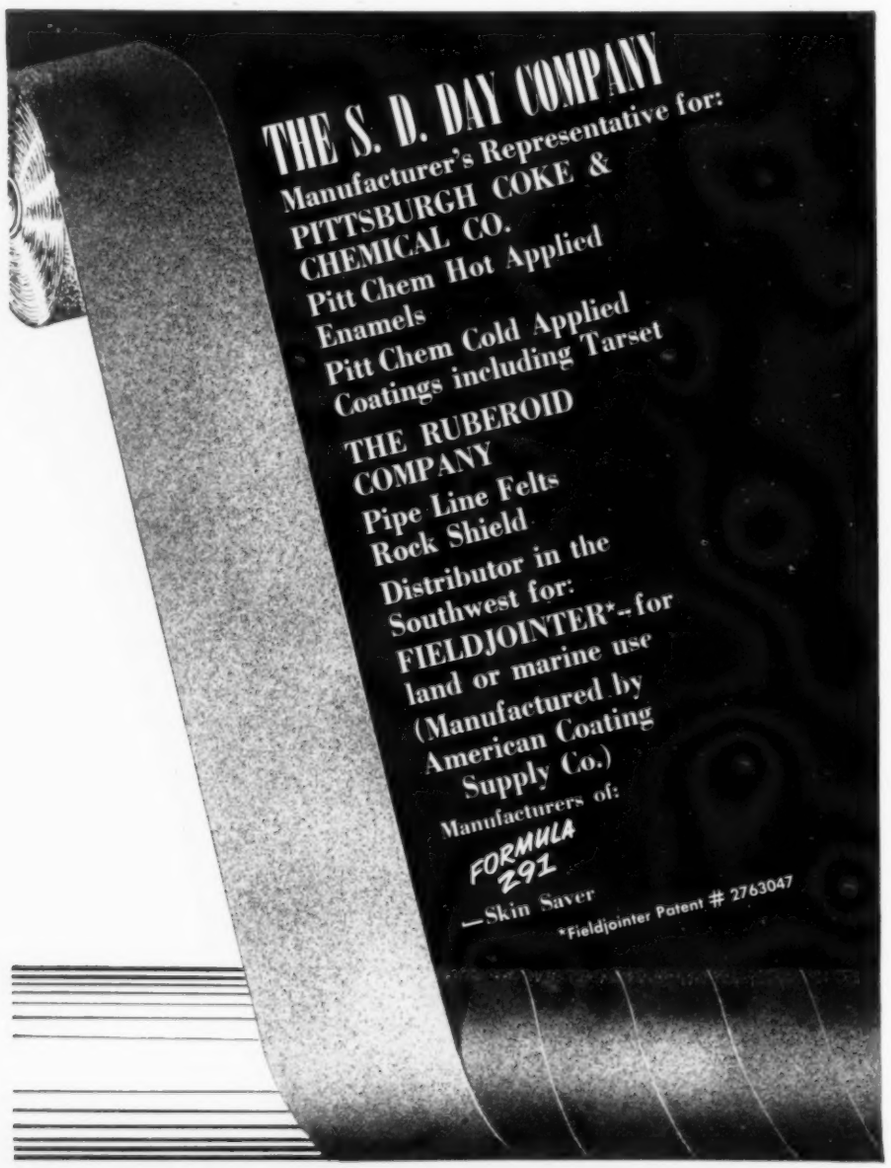
Allan Shivers will address the Tuesday afternoon session speaking on "Justice at the Wellhead." Tom P. Walker, chairman of the board of Transcontinental Gas Pipe Line Corporation, will deliver a talk on "Thoughts on Retirement," and Maj. Gen. William A. Carter, president of the Mississippi River Commission at Vicksburg, will discuss "Water Resources Development and the Gas Industry."

Companies Plan "Trans-Texas" Intrastate Line Extending to Dallas-Fort Worth

Plans are developing for the formation of a company to build a "trans-Texas" intrastate gas transmission pipe line from the Texas Panhandle to the Dallas-Fort Worth area.

Preliminary investigations indicate that the line will consist of about 290 miles of 24-inch running from the upper Texas Panhandle to the Permian Basin area. The remainder of the line, covering about 320 miles to Dallas-Fort Worth, will be made of 36-inch pipe. Gas transported by this line will be used for the industrial market in Dallas-Fort Worth area.

Phillips Petroleum, Pan American, and Delhi-Taylor are the firms involved in the proposed line. Humble also may be interested in supplying gas if the line is built.



Plans For Construction Of Trans-Utah Line Considered

Plans for a Trans-Utah gas pipe line, carrying the gas from Uintah Basin area across the state to Salt Lake City, are being considered. The 16-inch line would deliver about 50 Mmcf of gas daily.

Reserves from the Uintah, Duchesne and Grand counties transported across the state would be sold to Mountain Fuel Company.

The Trans-Utah line could put a strain on Pacific Northwest Pipeline Co.'s plan to take gas from the basin for delivery to Colorado Interstate Gas Co. as a part of the Beatrice project.

The plans hinge on a survey of Uintah Basin gas reserves. The report of that survey will be ready shortly.

Westcoast Transmission Co. Extends Gathering System

Westcoast Transmission Co., Ltd. has let contracts to Dutton-William Brothers, Ltd. for construction of 80 miles of 8, 10, 12, 18 and 20-inch pipe along the Alaska Highway in northeastern British Columbia.

The project is under way and is scheduled to be completed in August.

Pacific Lighting Gas Plans 128-Mile Transmission Line

Pacific Lighting Gas Supply Co. is planning a 128-mile, 34-inch gas pipe line to extend from Topock, Ariz., to Newberry, Calif. Gas will be obtained from the San Juan Basin system of El Paso Natural Gas Company in Arizona. The project has not been presented to the Federal Power Commission, but Pacific Lighting Gas expects to have it completed by November, 1959.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Chicago District Pipeline Company, 52 miles, 30-36 inch, gas, from Natural Gas' proposed line at Joliet to Chicago, $13 million, before FPC.

Coastal States Gas Producing Co., Corpus Christi, Texas, 45-mile, gas gathering system in Bee County, Texas to connect with Texas Eastern's main pipe line, $1 million, planned.

Coastal Transmission Corp., Houston, 574 miles, 22-24 inch, gas, from McAllen, Texas to Baton Rouge, La. connection of Houston, Texas Gas and Oil plus 414 miles of laterals, $55 million, authorized.

Colorado Interstate Gas Co., Colorado Springs, 734 miles, 24-30 inch, gas, from Texas & Okla. Panhandle to Kit Carson, Colo., to Beatrice, Neb., plus four compressor stations, $87 million, before FPC.

Conn-Mass Pipe Line, Inc., Orange, Conn., 88 miles, 8 inch, products, from Boston to Springfield, Mass., considered.

133 miles, 16-inch, products, from Linden, N. J. to Hartford, Conn., considered.

62.2 miles, 8-inch, products, from New Haven, Conn. to Springfield, Mass., considered.

38 miles, 6-inch, products, from Waltham, Mass. to Fitchburg, Mass., considered.

Deep Rock Gas Co., Oklahoma City, 120 miles, 6-inch, LPG, from Tioga, N. D., to Canadian border, planned.

Eastern Shore Natural Gas Company, Salisbury, Md., 124 miles, 6 and 8-inch, gas facilities on eastern shore areas of Delaware and Maryland, $3 million, authorized.

El Paso Natural Gas Co., El Paso, 835 miles, 4½-34-inch, field and main lines, facilities in Texas, New Mexico and Arizona, $80 million, 362 miles authorized and contracts let.

511 miles, 34-inch, gas from Twin Falls, Idaho, to California boundary near Las Vegas, planned.

4½ to 20-inch, field lateral lines, gas, in Texas, New Mexico and Arizona, authorized, before FPC.

18 miles, 12-inch, gas, loop between Good Field and East Vealmoor, Texas, temporary FPC authorization.

Emerald Pipe Line Corp., 120 miles, 6 inch, products, from Sunray, Texas, to Tucumcari, N. M., planned.

Equitable Gas Company, Pittsburgh, Penn., development of Rhodes natural gas storage pool in Lewis County, W. Va., and construction of 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

Everglades Pipe Line Company, Miami, Fla., 35 miles, 10-inch, products, Port Everglades to Miami International Airport, $2.5 Million, planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Interstate Gas Co., Houston, 12.8 miles, 6 and 20 inch, gas, loop line in Louisiana, $730,000, authorized.

350 miles, 30-inch, and 55 miles, 24-inch, loop lines in Kentucky, Mississippi, Tennessee, and Louisiana, $50 million, authorized.

Harry Bass & Sons, Inc., Dallas, pipe line network from well heads to compressor stations to central gasoline plant plus line to railroad in Pembina field, Alberta, $17 million, approved.

Home Gas Co., Pittsburgh, Penn., gas facilities in New York, $3.8 million, authorized.

Humble Oil & Refining Co., 250 miles, 26 or 30 inch, gas, and 200 miles, main gathering system, line of varying sizes, from southwest Texas to Houston, plus gas processing and cycling plant near Corpus Christi, $75 million, planned.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

Jayhawk Pipe Line Corp., Wichita, Kansas, 242 miles, 10 and 12 inch, crude, from western Meade County to Valley Center, Kansas, $8.6 million, planned.

Katy and New York Central Railroads, 2500-mile, 10-12 inch, LPG, from Houston, Texas, to New York, Considered.

Kerr-McGee Oil Industries, Inc., 24 miles, 4 inch, gas, to connect wells with its Breton Sound production island off the Louisiana coast, authorized.

Magna Pipeline Co., 40 miles, gas, underwater line from Anacortes, Wash., to Victoria, B. C., $6 million, planned.

Manufacturers Light and Heat Co., Pittsburgh, Penn., 13.8 miles, 10 and 12 inch, gas, facilities in Ohio and West Virginia, $757,300, authorized.

Michigan Gas Storage Co., Jackson, Mich., gas, facilities in central Michigan, $2 million, authorized.

Michigan-Wisconsin Pipe Line Co., Detroit, 472 miles, 4- 24-inch, gas, main line loops and extensions in Wisconsin, Illinois, $17.6 million, before FPC, temporary authorization for a part, 47.5 miles let to G. E. T. Construction, Inc.

148 miles, 4-20 inch, gas, line to connect new gas supplies in Laverne field, Northwestern Oklahoma, planned.

Midwestern Gas Transmission Co., 350 miles, 30-inch, gas, from Portland, Tenn. to Joliet, Ill., $45 million, before FPC. Proposed portion of original project extending to Canada.

Mookl Chemical & Gas Corp., Tulsa, and **Missouri Transmission Corp.**, Springfield, Mo., 425 miles, 16-inch, gas, from Oklahoma City area to St. Louis, before FPC.

Natural Gas Pipe Line Co. of America, 416 miles, 36 inch, gas, loops at various points along existing line between Beatrice, Neb., and Joliet, Ill., $76.2 million, before FPC.

396 miles, 30-inch, gas, loops between company's terminus near Fritch, Texas and Joliet, Ill., $63 million, before FPC.

New York State Natural Gas Corp., Pittsburgh, Penn., gas, facilities in New York state, $1.2 million, authorized.

North Carolina Natural Gas Corp., 630 miles, 2-16 inch, from Transco's system near Mooresville across to southeastern North Carolina, authorized.

Northern Natural Gas Co., Omaha, 167 miles, 20 inch, gas, from Farmington, Minn. to Duluth, Minn., and Superior, Wis., $12 million, before FPC.

42 miles, 10 inch, gas, from Rochester, Minn. to Winona and Goodview, Minn., $963,000, before FPC.

365 miles, gas, new facilities in Minn., Iowa, S. D., Neb., Wis., plus 1090 miles of branch line and station facilities, $65.7 million, authorization for a part. Gas facilities in Texas, Oklahoma and Kansas, $6 million, before FPC.

454 miles, main line loops and extensions, 6-30-inch, main line from St Cloud, Minn., to Grand Forks, N. Dak., also 1,490 miles of branch lines, 2-10-inch, and station additions totaling 32,000 horsepower, $86 million, planned.

27.6 miles, 30-inch, gas, loop; 18.3 miles north of Beaver station in Okla., 9.3 miles north of Sunray station in Texas, $3 million, authorized.

Northwest Pipeline Corp., Salt Lake City, 350 miles, 6-10 inch, crude, from Four Corners area to Salt Lake City, $15 million, considered.

Northern Utilities Co., 35 miles, 16 inch, gas, in Fremont Natrona County, Wyo., area; 8 miles, 12 inch, around Casper; 6 miles, 8 inch, from Sand Draw gas field to Beaver Creek field; 12 miles, 6 inch, from Beaver Creek field to the system servicing the Riverton-Lander area, planned.

Ohio Fuel Gas Co., Columbus, Ohio, 56 miles, 18-24 inch, gas, Richland County, Seneca County, Sandusky County to Toledo area, $4 million, contract for 22 miles awarded to H. L. Gentry Construction Co.

33 miles, 4 to 20 inch, various counties, Ohio, $1 million, authorized.

21.8 miles, 12 and 20-inch, natural gas facilities in various counties, Ohio, $1 million, authorized.

Ohio Oil Company, Findlay, Ohio, 350 miles, 12 inch, products, from Wood River, Ill. to Chicago, 84 miles let to Panama-Williams Corp.

Pacific Gas & Electric Co., 1300 miles, gas, from Alberta, Canada to Antioch, Calif., $380 million, planned.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., planned.

Pacific Northwest Pipeline Corp., Salt Lake City, 235 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $13.5 million, planned.

65 miles, gas, sales laterals in Washington, $1.5 million, planned.

52 miles, 30-inch loop Big Piney, Wyoming, gathering system, $5 million, planned.

Panhandle Eastern Pipe Line Co., Kansas City, 33 miles, 16 inch, gas, Muncie, Ind., lateral, planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8 and 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Permian Basin Pipeline Co., Omaha, Neb., 26.8 miles, 10 inch, gas, from a point on existing system in Pecos County, Texas, to a gasoline plant, $787,100, authorization.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

Shell Pipe Line Corp., Houston, 100 miles, 18-20 inch, crude, from Shell's Southwest Pass terminal to Shell's Norco Refinery near New Orleans, $10 million, planned.

Southern Kansas Pipe Line Co., Inc., Arkansas City, Kansas, 200 miles, 6-10 inch, crude, southwestern Kansas to Arkansas City, Kansas, planned.

Southern Natural Gas Company, Birmingham, 136 miles, 24 and 26 inch; 215 miles, various diameter supply lines; 3,650 additional compressor horsepower to White Castle and Toca Stations; 8 miles, 20-inch loops; 660 hp Franklinton station, and 23 measuring stations. $40 million, before FPC.

45 miles various diameter supply laterals; 2000 hp at Toca station; 660 hp at Franklinton; and measuring facilities; $4 million, authorized.

Tennessee Gas Transmission Co., Houston, 632 miles, 24 and 30 inch, gas, from Louisiana delta to Portland, Tenn. and Coudersport, Pa. to Hamburg, N. Y., temporary FPC authorization.

264 miles loop lines in Tennessee, Kentucky, West Virginia and Pennsylvania, temporary FPC authorization.

Compressor stations in Mississippi, Tennessee, New York, Pennsylvania and additions in Tennessee, Kentucky, Ohio and Pennsylvania, $129 million, temporary FPC authorization.

Texas Eastern-Penn-Jersey Transmission Corp., Shreveport, La., 65 miles, gas, from Delmont, Penn., to Lambertville, N. J., before FPC.

24,000 compressor hp additions to existing stations, $4.4 million, temporary FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La., 267 miles, 14-30 inch, gas, Louisiana, Mississippi, Pennsylvania and New Jersey, $50 million, before FPC. 59 miles, 30-inch, gas, loop additions to pipe line from Kosciusko, Miss. to Uniontown, Penn., $5.8 million, temporary FPC authorization.

96.5 miles, 30-inch, gas, between Kosciusko, Miss., and Uniontown, Penn.; 9.4 miles of supply laterals; a 10,250 hp compressor station, and 33,360 hp to existing compressor stations, $24.5 million, authorized.

Texas Eastern Transmission Corporation and Wilcox Trend Gathering System, Inc., gas, compressor stations, $4 million, authorized.

Texas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, Before FPC.

Transcontinental Gas Pipe Line Corp., Houston, 204 miles, 36-inch, 107 miles, 30-inch, main line loops in 10 states; 3 intermediate stations: North Carolina, Virginia, Pennsylvania; 2,500 additional hp at six compressor stations; 164 miles, 24-inch from Leidy storage Penn.; 29 miles, 30-inch, New Jersey; gathering lines, Louisiana, 119 miles; 10 meter stations; additions to West Cameron and High Island area, 35-miles, 16-inch, 26 miles, 10-inch, and three gathering meter stations; 45 miles, 16-inch, purchase laterals and 5 meter stations, Louisiana; 67 miles, 10, 12, 20-inch miscellaneous transmission purchase laterals in Texas and Louisiana, 3 meter stations; 51 miles, 36-inch and 1 mile, 30-inch in New Jersey; 51 miles, 10- and 14-inch and 3 meter stations, southeast Louisiana (mainly offshore), $137.3 million before FPC.

151 miles, 24-inch, 12 meter stations, southeast Louisiana, $14.5 million before FPC.

2,500 additional hp at four compressor stations, St. Francisville, La.; Laurel, Miss.; Linden, Ala. and Wadley, Ala., $3 million before FPC.

Wells, pipe lines, measuring equipment, stations at Leidy storage in Pennsylvania, $12.5 million before FPC.

Trans-Utah Pipeline, 16-inch, gas, main line from Uinta Basin to Salt Lake City, considered.

Transwestern Pipe Line Co., Dallas, 800 miles, 30-inch, gas. Four Corners area to California, $200 million, planned.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

United Gas Pipe Line Co., Shreveport, La., 203 miles, 30-inch, gas, between New Orleans and Mobile, Ala., $33.7 million, authorized.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Gas Trunk Line Co., Ltd., Alberta, 145-mile, 24-inch, south lateral from main junction north of Brooks to Pincher Creek, contract let to Piggott Construction, Ltd.

Crossings of Red Deer, Bow and Old Man Rivers, 24- and 26-inch, contracts let to Banister Construction, Ltd.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British Petroleum Co., 60 miles, crude, from deep water tanker terminal at Milford Haven, U. K. to Llandarcy Refinery, $18 million, planned.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India, planned.

Cie. de Recherche et d'Exploration de Petrole au Sahara, 530 miles, 16 inch, crude, Edjele field in Algeria to a port on Libyan coast, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Cuban Gas Transmission Co., 650 miles, gas, from Campeche area of Mexico across Yucatan and under Gulf of Mexico to Havana, Cuba, 120 miles would be submarine, considered.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

East Coast Transmission Co. (Pacific Petroleums, Ltd., Home Oil, Ltd., Canadian Homestead Oil, Ltd. and Merrill Petroleums, Ltd.), crude, from Alberta to Toronto, planned.

Elburz Oil Corp., 1000 miles, big inch, crude, from Central Iran to Alexandretta, Turkey, $450 million, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Iraq Joint Venture Pipe Line, 1200 miles, 38-40 inch, crude, from head of Persian Gulf through Iraq to Turkish coast of Mediterranean, $840 million, planned.

Iranian Consortium, 22 miles, 16 inch, and 30 miles, 16 inch, crude, from Agha Jari field to Bandar Mashur, planned.

Mene Grande Oil Co., 42 miles, 16 inch, crude, from Ceuta field in Lake Maracaibo to Bachaquero terminal, $6 million, planned.

76 miles, 30 inch, from Oficiana to Puerto La Cruz, Venezuela, considered.

61 miles, 6 inch, LPG, from Anaco to Puerto La Cruz, Venezuela, considered.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

Northwestern Utilities, Ltd., Edmonton, 75 miles, 16-inch, gas, from Pembina field to Edmonton, $3.5 million, contract let to Mannix Co., Ltd.

Petroargentina, Bahia Blanca, Argentina, 370 miles, 16 inch, crude, from Newguen to Bahia Blanca, Argentina, $40 million, planned.

Petroleos Mexicanos, 108 miles, 10 inch, gas, from Gral. Escobedo to Monclova

to tie into Reynosa-Monterrey gas pipe line, $9 million, planned.

600 miles, 24 inch, gas, from Pemex City to Mexico City, $50 million, planned.

38 miles, 4 inch, products, from Mexico City of Toluca, $500,000, planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

Royal Dutch Shell Co., 155 miles, 24-30 inch, crude, from German Rhineland to mouth of Rhine River, planned.

Saskatchewan Power Corp., Regina, Sask., 80 miles, gas, Hatton gas field to Success, Sask., planned.

40 miles, gas, Moose Jaw to Regina, Sask., planned.

Stanmount Pipe Line Co., 140 miles, 10 inch, crude, Cayiga and Beaver Lake fields, N. D., to connect with Interprovincial Pipe Line, planned.

Sturgeon Pipe Line Co., 100 miles, 12-inch, Sturgeon Lake field to Trans-Mountain system, $6.5 million, planned.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

83 miles, 10-inch, gas, from Rohri section headquarters of Sui-Karachi line to main Multan line on East bank of Indus in the Bhung vicinity, Pakistan, planned.

Trans-Europe Pipe Line, 700 miles, 30 inch, main trunk, crude, from Mediterranean to northern Europe, considered

Trans-Mountain Oil Pipe Line Co., 100 miles, loops near Kamloops, B. C. and Edson, Alta. plus pump station, tank farm and three temporary stations, $40 million, 50 miles let to Dutton-Williams Bros.

Westcoast Transmission Company, Ltd., 174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbian border, $45 million, planned.

650 miles, crude, from Peace River area to Vancouver, $100 million, planned.

Winnipeg and Central Gas Co., Winnipeg, Mant., 450 miles, 4-8 inch, LPG, from Tioga, N. D. to Winnipeg, Canada, $20 million, planned.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

Alberta Gas Trunk Line Co. Awards Several Contracts

Alberta Gas Trunk Line., Ltd, has awarded contracts to Piggott Construction, Ltd., and Banister Construction Co. for most of its 1958 program.

Piggott will construct the 145-mile, 24-inch south lateral from the main junction north of Brooks to Pincher Creek field. Eleven major canal crossings in the Lethbridge vicinity are included.

Banister has begun work on crossings of the Bow, Old Man and Red Deer rivers. Construction plans call for 24-inch pipe to be laid under the Bow and Old Man rivers with 26-inch pipe for the Red Deer.

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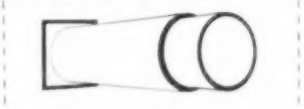

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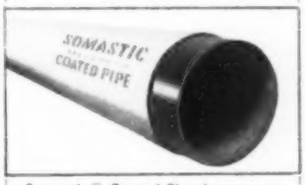

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PIPE LINE HINTS

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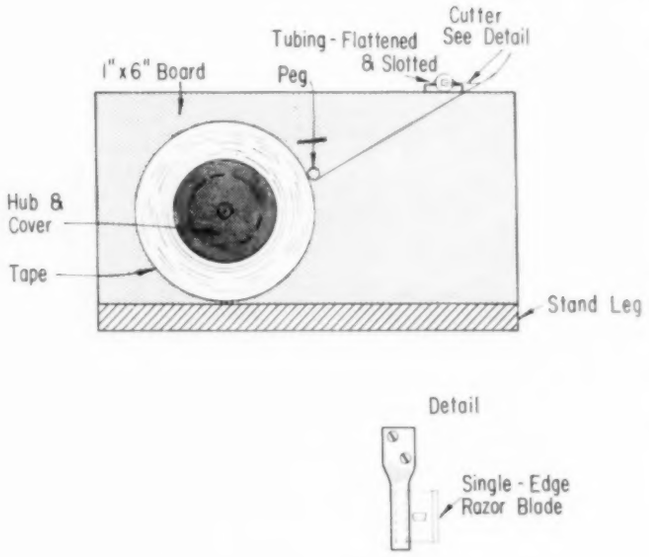
Small Pipe Frame Makes Sturdy Winch Support and Pipe Rack

A strong support for a front end winch and an added stand to hold extra joints of pipe can be made by replacing the standard truck bumper with a 2½- and 2-inch pipe frame.

The truck frame can be extended with angle iron with the winch set in a cradle between the bumper arms. A frame is then constructed around the extended truck frame with rollers on two upright members to make the winch line spool.

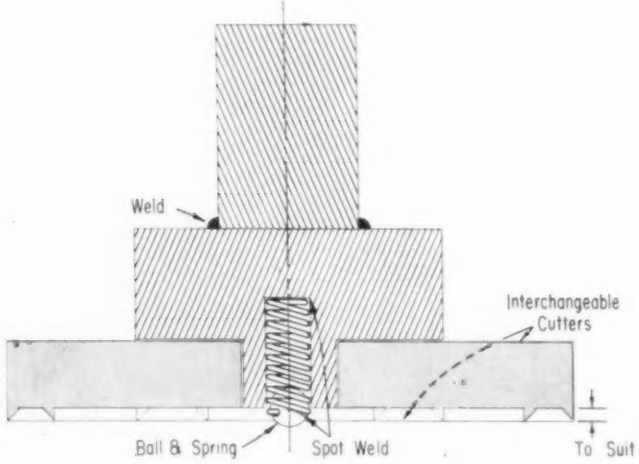
The pipe support is made by welding a saddle on top of a piece of 2-inch pipe. The pipe is then welded to the end of the front bumper. A piece of rubber hose is fitted on the saddle to prevent damage to coated pipe.



Razor Blade and Hub Make Pressure-Sensitive Dispenser

The dispenser shown in the sketch is handy whenever you have jobs to do which require using pressure-sensitive tape.

The roll of tape is mounted on a hub. A cover is screwed into it to keep the roll from falling off. The tape is run under a peg, which helps regulate it, and is cut by pulling up against a single-edge razor blade. The blade is mounted in a piece of tubing which has been attached to the board and slotted to accommodate the razor blade. A small piece of wood is attached to the board to act as a leg.



Handy Tool For Making Different Size Gaskets

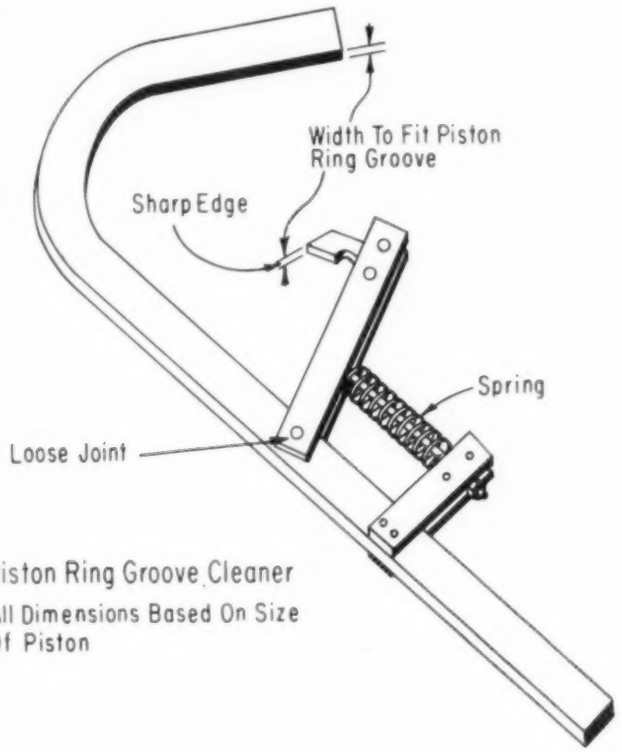
When making several different size gaskets from sheet material, you can save labor by using a tool as shown in the sketch above. Various size cutters can be turned on a lathe or milling machine and used interchangeably with the punch.

The punch houses a ball and spring to eject the center of the gaskets and is welded to a striking post. Cutters should be hardened to retain their edge.

Piston Ring Groove Cleaner Expedites Overhaul Work

A problem always exists when a large engine is going through its annual overhaul or periodic preventive maintenance. Most engines in service on pipe lines are large and require special tools to help expedite the overhaul work. One difficult job is cleaning piston ring grooves.

This special tool will help perform this tough job. It can be built to fit any size piston. Since it is a relatively simple piece of equipment, it can be built in most pump station shops.



Piston Ring Groove Cleaner
All Dimensions Based On Size Of Piston

Long-Handle Wrench Eases Operation on Plug Valves

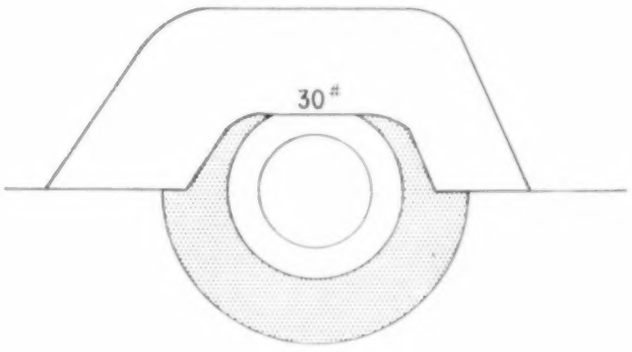
Where several valves of the same size are in the same vicinity, a wrench may be made which is cheap enough to be made particularly for these valves and, not being suitable for other uses such as are adjustable wrenches, it is always at hand for use on plug valves. Fabricated from three-quarter inch bar stock, a bend is made near the center of a five foot piece so that the square corners formed will fit over the square on the end of the plug. After the short end is brought back and a tack weld made in the long end, a small piece is cut to fit across the back of the plug so that the plug is "boxed in" on all four sides.

By using a long wrench which fits snugly, hammering on the plug is kept to a minimum and the adjusting nut is kept tight at all times. The valve may be turned on and off by moving it through a quarter turn with the home made wrench.

Mark Correct Tire Pressure on Fenders Above Each Wheel

In large companies where vehicle operators use different trucks for various jobs, the driver is often confused over the correct tire pressure. Pickup, gang-truck, float and trailer tires are of various sizes; therefore recommended pressures by the manufacturer will vary considerably for each size tire.

One operator established a system to insure that the correct tire pressure was applied by service station attendants or new employes. The correct tire pressure was stenciled on the fender above each wheel on all company vehicles. There was never any further question concerning the correct tire pressure, regardless of the unit to be serviced. This system increased the tire life on all units and also made drivers and employes servicing the equipment more conscious of the importance of correct tire pressure.

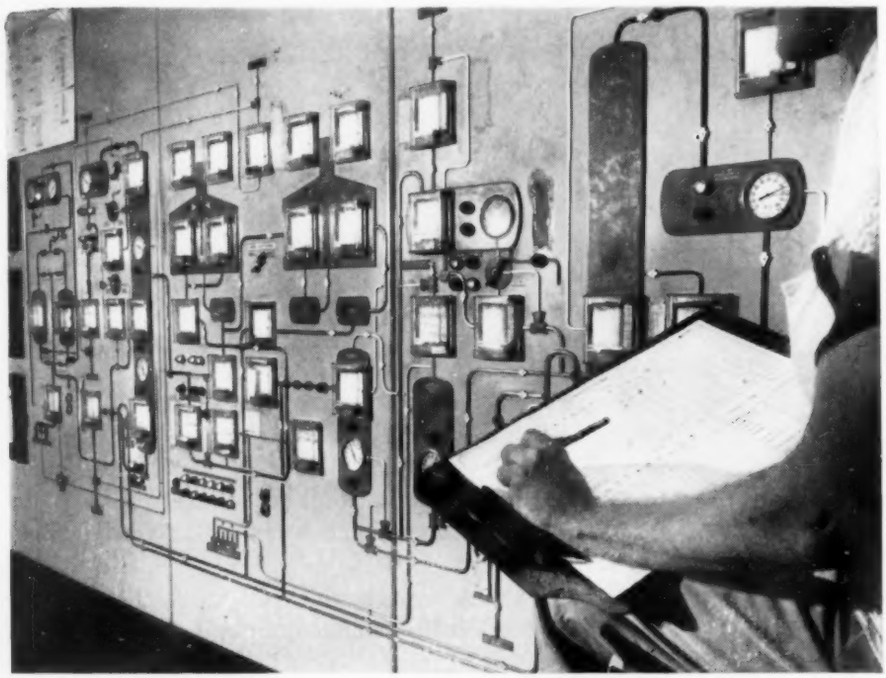


Cement Blocks Support Blowoff Lines

Supports made of concrete blocks and 2-inch pipe will keep blowoff lines erect and the pipe in alignment where a block valve is placed in the line.

Cement blocks are placed in holes dug under the pipe on each side of the blowoff lines and under the block valves to keep it in perfect alignment during expansion and contraction of the line.

Four braces made of 2-inch pipe are welded to the top end of the stand pipes. Two of these are welded to the pipe line; two are sunk in the cement block, forming a solid unit. The risers and frames and block valve are wrapped with plastic tape to prevent corrosion before the concrete is poured.



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Half of Car Tire Rim Used To Make Hanger for Air Hose

Half of an automobile wheel can be used to make a hanger for the air hose or other hoses used around a pipe line station. The wheel is cut in half with a welding torch and the inside part of the wheel is cut out leaving only the rim.

A bar is welded across the ends and drilled for bolt holes. Holes are then drilled in the wall, and expanding bolts used to hold the hanger in place at a convenient height. The hose is hung so that the nozzle hangs downward, and miscellaneous connections for the nozzle are laid at a conveninet place on the cross member.

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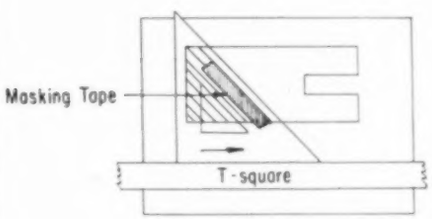
Side Boom Built on Truck Facilitates Pipe Handling

Where pipe lines are to be laid on fairly smooth, flat terrain, a sideboom may be built on the front bumper of the truck to support the joints. It is made by welding a 2-inch upright piece of pipe to a clevice on the left side of the front bumper and building a cantilever beam by bending two other pieces for bracing.

The longer bent piece is fastened to a clevice on the right end of the bumper and the shorter bent piece is set between the upright piece and the end of the boom. Another section of 2-inch pipe is run from the end back to the side of the frame to give triangular support. One-inch pieces are then used to brace the cantilever.



Masking Tape and Triangle Used for Cross Sectioning

Here is a simple and convenient method for accurately drawing cross-hatched (cross sectioning) lines uniformly-spaced.

Place a piece of masking tape on a triangle with an edge of the tape parallel to the edge of the triangle. Make the distance between the edge of the tape and the edge of the triangle the desired width of the cross-hatched lines.

Begin from the bottom of the cross-hatched section placing the triangle with the edge of the tape coinciding with the first line. Repeat the process with each successive line until the entire section is cross-hatched.

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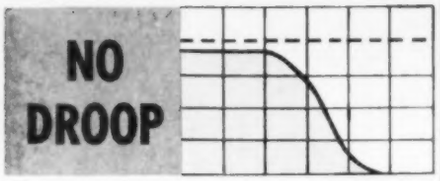

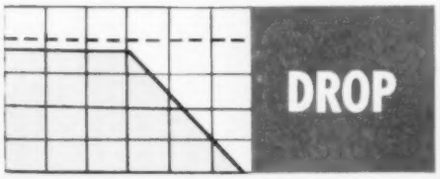

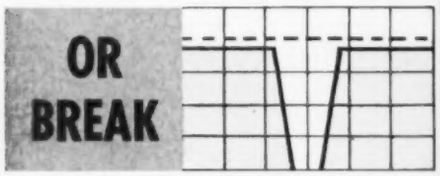

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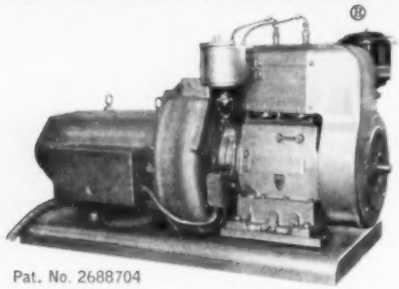

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Canadian Contractors Elect Officers

The Pipe Line Contractors Association of Canada elected new officers at the annual conference in Victoria, B. C. Seated in the picture, left to right, are R. K. Bannister, Fulton-Bannister Ltd., director; C. A. Callahan, Majestic Contractors Ltd., president and G. A. Wilkinson, Marwell Construction Co. Ltd. Back row, left to right, are R. G. Murray, Dutton-Williams Bros., director; Robert Thomas, River Construction Corporation, director; Gordon Walker, Mannix Co. Ltd., first vice president; E. A. Hooper, F. E. Shaw, Ltd., second vice president and A. O. Ackroyd, executive secretary.

William B. Fowler has been promoted to assistant director of the Property Taxes department of **Texas Gas Transmission Corporation. Dennis L. Newberry** has been made manager of gas sales. **Glover H. Cary, Jr.,** was named industrial representative.

William B. Fowler

Fowler will work with state and local tax groups in the nine states in which Texas Gas properties are located. Fowler has been with the company since 1950.

Newberry will be responsible for obtaining market data from the company's customers and for coordinating gas sales development by present and potential customers. Cary will work in connection with Texas Gas efforts to further industrialize those areas of eight states to which it will deliver gas. Newberry has been with the company since 1951 and Cary since 1950.

•

Gulf Oil Corporation announces the promotion of **H. Barksdale Brown** to general coordinator of the Transportation department. Brown, prior to his promotion, had been marine coordinator for the Transportation department. At his new position, he will be responsible for coordination of all forms of transportation for the company and its subsidiaries.

Brown joined Gulf Oil in 1950 as a member of the executive department dealing with marine matters. In 1955 he became marine coordinator.

Charles A. Schrader has been elected president of the **Leonard Crude Oil Company,** succeeding the late **Delbert Y. Hewitt.** Schrader previously was administrative vice president for supply and transportation with **Leonard Refineries, Inc.**

Schrader entered Michigan oil business in 1947 as vice president of **Mid-West Refineries, Inc.** He became president and a director of **Michigan-Ohio Pipeline Corporation** in 1950. •

Tennessee Gas Transmission Company has announced several appointments. **J. Spencer Collins** has been promoted to exploration manager of the Producing division; **W. C. Tillet** was made manager of exploration contracts; **George E. Burgher, Jr.,** was named manager of exploration properties; and **L. B. Vaden** was appointed manager of exploration acquisitions.

J. Spencer Collins

Collins will be in charge of domestic and Canadian operations. He has been staff manager, exploration, since 1957 and previously had been in different geology divisions. Tillet will be responsible for coordination of the preparation, approval, execution and distribution of all agreements affecting leasehold, mineral or fee properties owned by the company and administered by the Exploration department.

Collins, Burgher and Vaden have been associated with Tennessee Gas since 1954.

For more data on advertised products, use Readers' Service Cards, last page.

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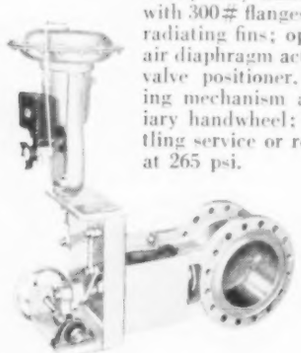
Heavy duty, wafer-type butterfly valve with worm gear and handwheel for high pressure and for high temperature service in pipe line flow control and shut-off of petroleum, gas or water.



Heavy duty butterfly valve with 300# flanges and heat-radiating fins; operated by air diaphragm actuator and valve positioner, declutching mechanism and auxiliary handwheel; for throttling service or recycle gas at 265 psi.

Lubricated swing gate valve for high pressure gas; closed by lubricant pressure and (unlike plug valve) is opened by release of lubricant pressure.

Rockwell valves for petroleum production, refining and pipe line service are designed in many types with manual or automatic control operators, in required metals, body linings and pipe sizes. Write for catalog.

W. S. ROCKWELL COMPANY
2728 ELIOT STREET
FAIRFIELD, CONN.

Joint Committee Meeting

Members of the API Automation Committee and the Liquid Pipe Line Committee of the Instrument Society of America met at a joint gathering held at the Service Pipe Line Company in Tulsa. The meeting's prime objective was to promote a standardization program and determine a method of distributing knowledge in order to further automation techniques in liquid pipe line industry. Pictured in the front row, left to right, are R. J. Osborn, Sinclair Pipe Line Co.; Max. T. Nigh, Service Pipe Line Co. and ISA Committee chairman; and Allen Heiderbrecht, Platte Pipe Line Co. and chairman of API Automation Committee. In the back row are, left to right, C. G. Wrigley, and P. P. Plovonich, Service Pipe Line; Fred S. Jones, Platte Pipe Line Co.; Lloyd E. Cook, Sinclair Pipe Line; E. A. Nelson, Interstate Oil Co.; T. C. Schroeder, Union Switch & Signal, and Joseph Purvine, Cities Service Co.

Joe T. Dickerson, president of **Shell Pipe Line Corporation** has been named general chairman of the 1958 Southwest Area Conference on Industrial Relations, and he was elected president of the United Fund of Houston and Harris County for the next year.

Joe T. Dickerson

The industrial relations conference will be held May 9-10 at the Rice Hotel in Houston. Dickerson was chairman of the 1958 United Fund campaign. Dickerson joined Shell in 1927 as an attorney. In 1933 he became manager of the Legal department in Tulsa. He was appointed president of the company in 1954.

Michigan Consolidated Gas Company has announced three administrative appointments. **Alvan V. Brashear** has been elected a vice president and manager of operations; **Peter J. Monaghan** has been appointed to the board of directors, and **Albert F. Mullins** is the new assistant general manager of the Grand Rapids district.

Brashear has been with Michigan Consolidated 34 years and in 1953 became assistant manager of operations. Monaghan has been practicing law since 1934 and is senior partner in the firm Monaghan & Monaghan & Crawmer.

Mullins joined a Michigan subsidiary, Grand Rapids Gas Light Company, in 1924 and since 1938 has been assistant treasurer of that company.

•

Ben R. Howard has joined the **Republic Natural Gas Company** as chief geophysicist. Previously, Howard worked for **Socony Vacuum** in Venezuela and later was employed by **Warren Petroleum Corporation** where he was chief geophysicist.

Laco

pipeline contractors
Incorporated
•
Houston, Texas

W. R. Stephens has been elected president of **Arkansas Louisiana Gas Company** succeeding the late **J. C. Hamilton.** Stephens will also continue in the position of chairman of the board of Arkansas Louisiana.

D. W. Weir has been promoted to the newly created position of executive vice president and elected to the board of directors and **Lindsey Hatchett** was named vice president of the company. A new subsidiary, **Arkansas Louisiana Chemical Corp.,** has been formed for extraction and production of materials used in the chemical industry.

•

William B. Padon has been elected a vice president and director of **Transwestern Pipeline Company.** Padon has been vice president in charge of projects and planning of **Warren Petroleum Corporation** since 1956.

•

Harry H. Siert

Bill Quinlan

Jim Finnegan

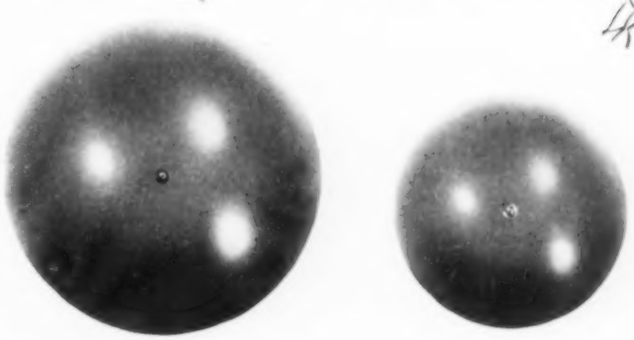
Bob Adwers

Northern Natural Gas Company has announced a new vice president and several promotions in its Public Relations and Publications departments. **Harry H. Siert** has been promoted from treasurer to vice president and treasurer. **Bob Adwers** has been named supervisor of films and visual aids. **Vern Dalton** has been appointed public information assistant. **Jim Finnegan** has been named supervisor of public information and **Bill Quinlan** is the new supervisor of advertising and promotion.

Siert has been with Northern 21 years and had been treasurer since 1948.

Adwers, a 20-year veteran with Northern, had been special assistant in the Public Relations department. Dalton previously had been associate editor of Northern Natural News and Transmission magazines. Finnegan, who joined the company 10 years ago, has been publications editor since 1952. Quinlan joined Northern Natural in 1937, became magazine editor in 1946 and in 1952 was promoted to publications director.

New
"Something From The Irishman"



PIPELINE SPHERES . . .

. . . the new way to improve the efficiency of Products Lines.

Over four years of intensive research involving the testing of literally hundreds of rubber compounds in the laboratory, and thousands of miles of field tests in Products Lines have established the superiority of the **Maloney Pipe Line Sphere** over existing methods of product separation and meter calibration. This superiority is demonstrated in **ease of handling** — saving costly man-hours of labor; **long life** — reducing expensive replacement time and labor; and **flexibility** — complete adaptability to automated systems and ability to follow flow through short radius bends, tees, etc.
All of these advantages are obtained with a marked reduction in interface contamination and no loss in accuracy.

The **liquid-center rubber Sphere,** with its obvious handling advantages, has an even greater advantage in wear characteristics; with an infinite number of wearing surfaces in comparison to the conventional dumbbell pig. This advantage is apparent in test results of over 500 miles without excessive wear, indicating that in normal use **runs of over 1,000 miles can be expected.**

Research on the **Maloney Pipe Line Sphere** is continuing in an effort to determine the final extent of its overwhelming superiority when compared with other methods of calibration and separation. Other uses for the **Pipe Line Sphere,** such as water or product removal, etc., are also being investigated.

Maloney Pipe Line Spheres are presently available in the following sizes: 4, 6, 8, 10, 12, 14, 16, and 20 inches.
Our Engineering and Research departments are prepared to make specific recommendations for your particular applications.
Additional information is contained in bulletin PS.
Your inquiries are invited.

MANUFACTURED BY

F. H. Maloney COMPANY

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Wilson N. Gilliat has been promoted from chief engineer to assistant vice president-engineering, and Charles J. Flint has been named chief engineer for **Williams Brothers Company.** Gilliat has been with Williams Brothers since 1954; formerly he had been study engineer for Great Lakes Pipe Line Co. Flint, who joined the company in 1955, has been responsible for engineering and economic studies, and design of turnkey pipe line projects.

Wilson N. Gilliat

C. F. Dohm has been elected president and director of **Pan American International Oil Co.** Pan American International is a newly formed sudsidiary of **Pan American Petroleum Corp.,** organized to carry out oil exploration and development operations in the Eastern hemisphere.

Dohm formerly was president and director of **Conorada Petroleum Corp.** He has had more than 20 years experience in oil exploration and development activities abroad. He was associated with **Standard Oil Co. (New Jersey)** and affiliates from 1937 to 1949 in various Central and South American countries.

•

Westcoast Transmission Company announces the appointment of **Col. Victor Spencer** to the board of directors. Spencer is president of Spencer Realties Ltd., Pacific Nickel Mines Ltd. and chairman of the board of Vancouver Iron Works and Pioneer Gold Mines of B. C. Ltd.

•

Cities Service Oil Co. has named **Perry E. Barnhart,** district geologist in its Lafayette, La., office. **Bill James** has been named to succeed Barnhart as district geologist at Midland, Texas. Barnhart succeeds **I. C. McCasland** who has accepted a foreign position. James and Barnhart had been stationed in Midland since 1956.

•

Frank H. Stone, manager of the Natural Gas and Gasoline department of **La Gloria Oil and Gas Company,** has been named a vice president of the company. Stone will be in charge of processing activities including direction of the Falfurrias gas processing plant and the Tyler refinery. He has been associated with the company for 12 years and became manager of the Natural Gas-Gasoline department in 1949. Stone is also on the board of directors of the Natural Gasoline Association of America and a member of A.P.I.

Frank H. Stone

•

Ernest R. Shearer is the new superintendent of the Midwest Products division, and **Charles W. Tomford** has been appointed manager of the newly organized Planning and Development department of **Buckeye Pipe Line Co.** Shearer was formerly assistant superintendent of the Cynet division, and Tomford had been the superintendent of the Midwest Products division.

•

United Gas Pipe Line Company has announced two appointments in administrative positions. **L. C. Poindexter,** has been appointed chief engineer, and **C. W. Hollenshead** has been named superintendent of pipe line operations for the Eastern division. Poindexter is a member of the board of directors and prior to his promotion was pipe line superintendent for the Eastern division. Hollenshead joined United Gas in 1935 as a draftsman, and since 1948 he had been assistant to pipe line superintendent for the Eastern division.

•

D. L. Kastner has been promoted to the newly created post of assistant general superintendent in **Cities Service Oil Co's** Production division. **E. L. Cralle** succeeds Kastner as assistant division superintendent at Odessa. Kastner has been with Cities Service since 1947, and Cralle started with the company in 1947 as a member of the engineering training school.

•

Lone Star Gas Company announces the election of **Avery Mays** to the board of directors. Mays is a general contractor and developer of real estate projects in Dallas. He is the owner of the Avery Mays Company.

Houston Contracting
MEN OF EXPERIENCE
Build Better Pipelines

EARL NORRIS — General Superintendent. 21 Years' Experience with Houston Contracting Company, Earl is Typical of the Personnel Who Are Your Guarantee of Better-Built Pipelines.

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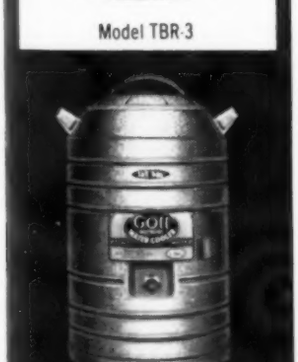
Model TBR-3



Model TBR-5 — Also available in 10-gal. size Model TBR-10

ANOTHER

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Set it on the ground, rig floor, or any flat surface. Useable anywhere! GOTT'S new "Tower Base"—engineered to provide a higher faucet that permits cups to be filled without holding the cooler or providing a stand. New convenience for "on the job" or "in the field"!

The Gotkool "TALL BOY" is another superior product by H. P. GOTT Mfg. Co., famous for 41 years for GOTKOOL water cans and coolers. First with the double wall thermo design! Sweat-soldered seams! Soldered faucets! Only GOTT brings you so many exclusive features for longer service, rugged wear! Of course, standard models are still available as always.

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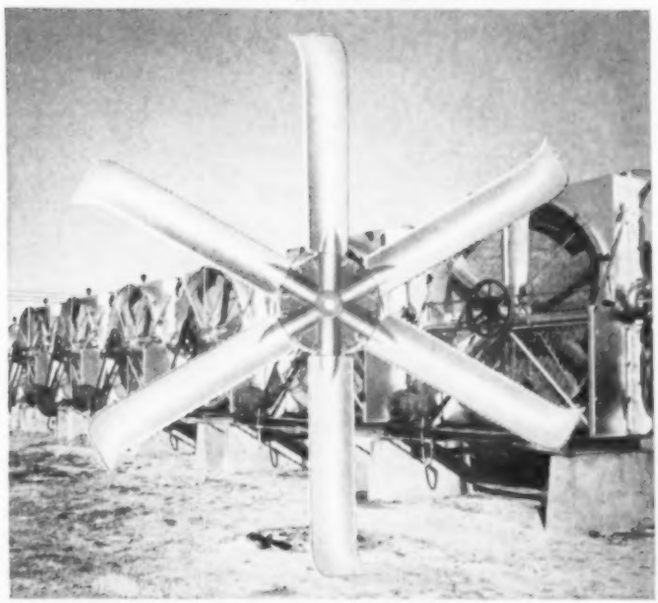
new adjustable pitch

"macheta" airfoil

Aerovent

54"–96" propellers



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Latest innovation is the use of "T-ALLOY" for extra strength and additional corrosion resistance in especially rugged applications. Inherently a high-strength alloy, "T" provides better resistance to shock and vibration. This, plus *individual blade balancing* for complete interchangeability of all units and *universal pitch markings* to simplify accurate field setting, is your assurance of dependable, lasting performance in any installation.

STANDARD CONSTRUCTION ALUMINUM-ALLOY BLADES FURNISHED FOR ALL NORMAL-DUTY REQUIREMENTS

CAST ALUMINUM HUBS for light weight and ease of handling feature bolted construction for fast, easy assembly.

"POSITIVE-LOCKING" Pitch Adjustment is accomplished by keyways which hold peripheral-keyed blade shanks.

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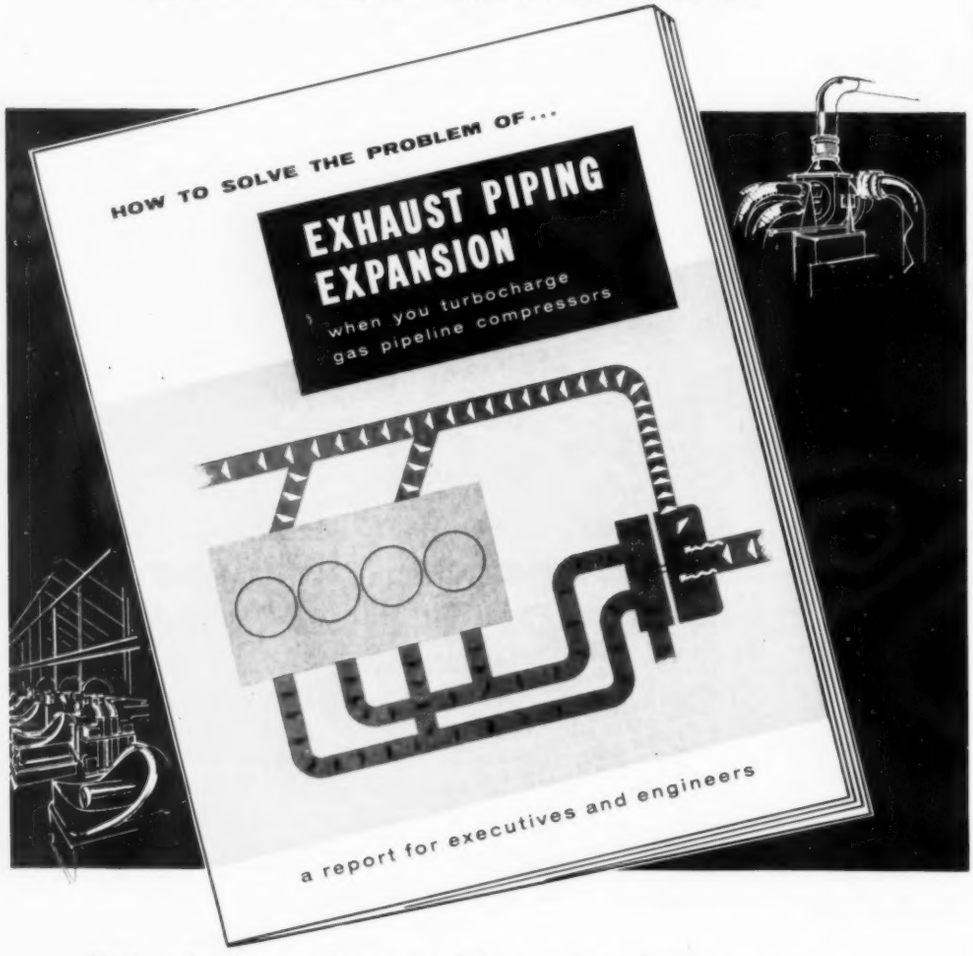
EXHAUST PIPING EXPANSION

WHEN TURBOCHARGING GAS PIPELINE COMPRESSORS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a report for executives and engineers

Write today for your free copy of this easy-to-read report on a most important and lively topic—*increasing gas pipeline capacity by turbocharging existing compressors in the field.* The report tells you the dollars-and-cents facts that led an important gas pipeline company to a complete turbocharging program.

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WHO'S MEETING WHERE

April

ASME Maintenance & Plant Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, April 1-15.

API, Division of Production, Mid-Continent District Meeting, Biltmore Hotel, Oklahoma City, April 9-11.

Tenth Southwestern I.R.E. Conference & Electronics Show, St. Anthony's Hotel and Municipal Auditorium, San Antonio, Texas, April 10-12.

Pipe Line School of Technology, sponsored by The University of Texas, Baytown, Texas, April 14.

ASME Design Engineering Conference, International Amphitheater, Chicago, April 14-17.

American Welding Society, annual welding show, Kiel Auditorium, St. Louis, April 15-17.

Thirty-fourth Annual Gas Measurement, short course, sponsored by University of Oklahoma, North Campus, Norman, Okla., April 15-17.

Natural Gasoline Association of America, annual convention, Baker & Adolphus Hotels, Dallas, Texas, April 16-18.

National Petroleum Association, fifty-fifth semiannual meeting, Hotel Cleveland, Cleveland, April 16-18.

Petroleum Equipment Suppliers Association, Pacific district meeting, Beverly-Hilton Hotel, Los Angeles, April 17.

American Institute of Mining, Metallurgical, & Petroleum Engineers, Louisiana-Arkansas, East Texas, & Mississippi petroleum sections, gas technology symposium, Shreveport, La., April 17-18.

API, Division of Production, Rocky Mountain District Meeting, Cosmopolitan Hotel, Denver, April 21-23.

Independent Petroleum Association of America, midyear meeting, Hotel Sherman, Chicago, Ill., April 27-29.

Third Annual Conference on Automatic Control in the petroleum & chemical industries, sponsored by University of Oklahoma, Oklahoma Memorial Union Building, Norman, Okla., April 28-29.

Southern Gas Association Annual Convention, Dallas, April 28-30.

PIEA & PESA joint convention, Adolphus Hotel, Dallas, Texas, April 29-May 1

May

LPGA, 27th annual convention, Conrad Hilton Hotel, Chicago, May 4-7.

Institute of Radio Engineers and American Institute of Electrical Engineers, 1958 Western Joint Computer conference Ambassador Hotel, Los Angeles, May 4-7

American Gas Association, distribution, production and transmission conference, Roosevelt and Commodore Hotels, New York, May 5-9.

API, Division of Production, Eastern District Meeting, Deshler-Hilton Hotel, Columbus, Ohio, May 7-9.

American Society of Mechanical Engineers, Oil & Gas Power Division 30th annual conference and exhibit, Philadelphia, Pa., May 12-15.

Second Annual Stationary Industrial Engines, course sponsored by University of Oklahoma, at Norman, Okla., May 13-14.

Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa., May 20-22.

Rocky Mountain Oil and Gas Association, thirteenth annual convention, Cosmopolitan Hotel, Denver, May 21-23.

API, Division of Production, Pacific Coast District Meeting, Biltmore Hotel, Los Angeles, May 22-23.

June

P.E.P.A. 30th annual meeting, Texas Hotel, Fort Worth, Texas, June 2-4.

A.I.E.E., A.R.S., I.S.A., and L.A.S., 1958 National Telemetering Conference, Lord Baltimore Hotel, Baltimore, Md., June 2-4.

API, division of transportation, annual tanker conference, Greenbrier Hotel, White Sulphur Springs, W. Va., June 8-11.

Appalachian Underground Corrosion Short Course, school of mines, West Virginia University, Morgantown, W. Va., June 10-12.

Michigan Gas Association, Grand Hotel, Mackinac Island, Mich., June 21-22.

American Society for Testing Materials, annual meeting and exhibit, Hotel Statler, Boston, Mass., June 22-28.

Pipe Line Division, A.S.C.E. Convention, Multnomah Hotel, Portland, Oregon, June 23-25.

Interstate Oil Compact Commission, mid-year meeting, Hotel Utah, Salt Lake City, Utah, June 23-25.

Canadian Gas Association, annual meeting, Manoir Richelieu Hotel, Murray Bay, Quebec, June 24-27.

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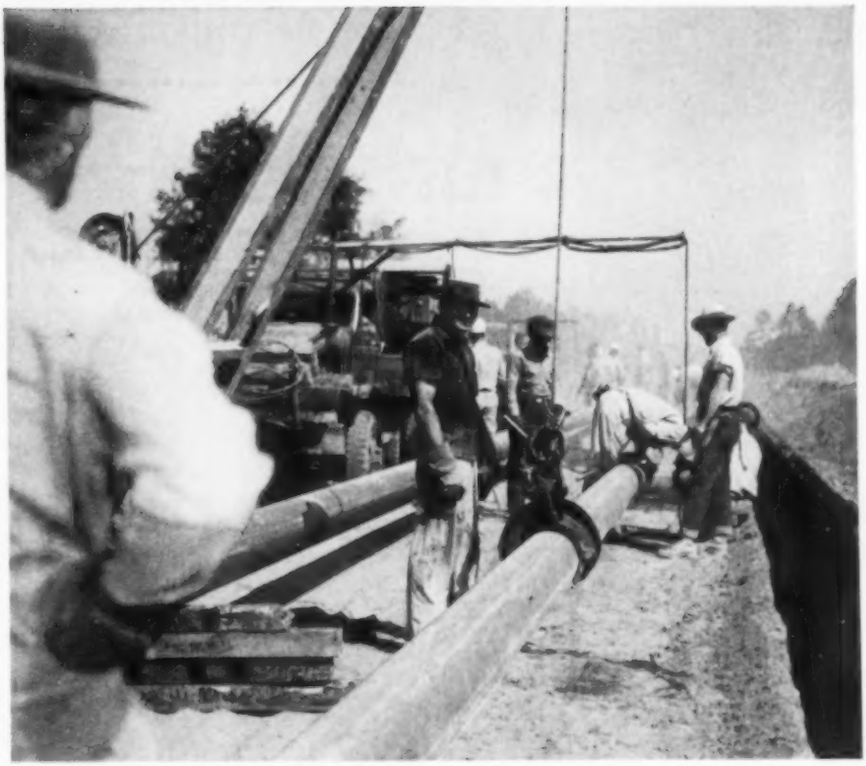

you can depend on Lone Star API pipe

. . . quality controlled for long, trouble-free service

Crossing rivers, bending over steep hills and rugged terrain is routine for Lone Star electric weld line pipe. Joe Roughneck, heart of the oil and gas industry, knows he can depend on Lone Star API casing, tubing and line pipe . . from the oil country's own steel plant. Fully normalized, of course.

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For more data on advertised products, use Readers' Service Cards, last page.

This report helps you save on pump-station maintenance

Here's a new Oakite Service Report – free, of course – on maintenance cleaning at the pipeline pumping station.

It's full of valuable, time-saving ideas ... any one of which might turn out to give you a deep cut in maintenance costs. You'll find helpful shortcuts on:

- Engine room maintenance
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What's Happening among SERVICE and SUPPLY MEN

J. R. Harrahill

Stephen Hodges

E. R. Torgler

Charles Kuhn

Dresser Manufacturing Names Several Managerial Promotions

Dresser Manufacturing Division announces several promotions in its manufacturing departments. E. R. Torgler has been named director of manufacturing for the company and its subsidiaries. J. R. Harrahill has been appointed acting works manager. Charles Kuhn has been named sales manager, regular products, and Stephen B. Hodges has been promoted to director of marketing plannning and control.

William H. Rowell and John P. Lord have been appointed product managers for bolted couplings and welding fittings, respectively.

Torgler will provide guidance, planning and control in many manufacturing undertakings and opportunities for improvement in the United States and Canada. He will also supervise the Industrial Relations and Personnel departments at Bradford.

Dr. Karol Pilarczyk Named De Laval Research Director

Dr. Karol Pilarczyk has been named director of research and development for the De Laval Steam Turbine Company. The staff of the research and development has been increased for an expanded program. W. H. Wiebe remains chief research and development engineer and H. W. Ebeling superintendent of engineering laboratory.

Whiteneck, Godard and Stegner Elected Officers of NACE

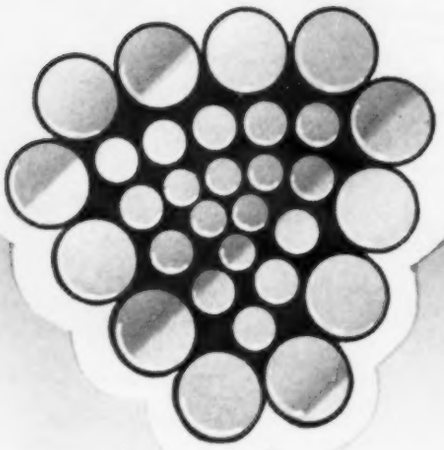
L. L. Whiteneck, vice president and director of materials research for Plicoflex, Inc., has been elected president of the National Association of Corrosion Engineers. Other officers include Hugh P. Godard, Aluminum Laboratories, Ltd., vice president, and A. L. Stegner, Tennessee Gas Transmission Company, re-elected for a second term.

General Electric Appoints Corbell Microwave Manager

I. Tunis Corbell has been named manager of microwave design engineering for General Electric's Communication Products department. Corbell will be responsible for microwave systems engineered for utility firms, pipe line companies, toll road authorities and other types of users.

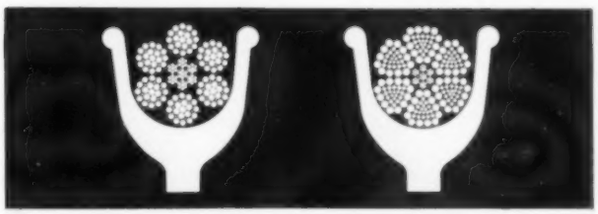
I. Tunis Corbell

He succeeds A. Clarke Gunn, now manager of design engineering for military equipment. Corbell joined General Electric in 1950 and has worked in microwave relay since the development of the commercial microwave in the communications industry.



SHAPE *with a future*

This is a cross section of one strand of a Flattened Strand Wire Rope showing the triangular arrangement of wires. This is the secret of the success of Yellow Strand Flattened Strand Wire Rope. Visualize how the flat surface of this strand runs smoothly over sheaves and drum on your equipment . . . load weight and wear are distributed over many wires instead of just a few. This construction makes possible a 10% greater metallic area, a marked increase in strength plus a compactness and crush resistance unobtainable in round strand rope. The benefits Yellow Strand Flattened Strand brings to the pipeline industry are obvious . . . longer rope service life, less down time, greater profits! Ask your Broderick & Bascom Distributor about Yellow Strand Flattened Strand. For *your* future's sake specify long-lived, money saving B & B products. Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.



LOAD DISTRIBUTED OVER 12 CONTACT POINTS

Compare Yellow Strand Flattened Strand (right) with round strand wire rope (left). Note how Flattened Strand gives 12 points of contact with sheave groove, with consequent greater bearing area and smoother surface. This results in longer service life for rope, sheaves and drum.

Yellow Strand®

Wire Rope

For more data on advertised products, use Readers' Service Cards, last page.

Burgess-Manning Announces Two District Appointments

J. A. Kolb has been named sales engineer in the New York district offices, and Louis G. Halla has been appointed sales engineer for the Chicago district office for the Burgess-Manning Company, Industrial Silencer division.

Kolb has served the past three years as field sales engineer in the Chicago area. Halla previously was associated with Walker Process Equipment, Inc., and Wallace & Tiernan, Inc.

Allis-Chalmers Announces Appointment of E. F. Greiwe

Allis-Chalmers announces the appointment of E. F. Greiwe as manager of the Norwood Works Centrifugal Pump department. Greiwe succeeds M. L. Murdock, who resigned.

Greiwe has been with Allis-Chalmers since 1936 and since 1955 he has been manager of product sales, Electrical department, Norwood Works. Murdock had been manager of Norwood since 1949.

Van Valkenburg Appointed Director of New Division

E. J. Van Valkenburg will assume the position of director of the newly organized Procurement and Material Service division of ALCO Products, Inc.

Van Valkenburg, who has been with the company for 37 years, will supervise procurement, warehousing, inventory control and distribution of obsolete materials, supplies and equipment. Among his responsibilities will be analysis services for ALCO's four product divisions.

Thomas H. Pike

John E. Chumbley

Thomas Pike, John Chumbley Named Division Vice Presidents

Thomas H. Pike and John E. Chumbley have been named division vice presidents, and F. E. MacDonald has been appointed controller for Tube Turns.

Pike will be in charge of planning, and Chumbley will head general sales operations for the division, manufacturer of welding pipe fittings and flanges and custom forgings.

Pike joined Tube Turn in 1940 as district manager in Los Angeles, was promoted to assistant manager at the main office in 1945 and became merchandising manager in 1955. Chumbley has been with the company since 1937. He became assistant general sales manager in 1953. MacDonald, who has been with the firm since 1937, was made assistant controller in 1945.

BS&B International Announces Opening of Venezuela Division

BS&B International, S.A., a wholly owned subsidiary of Black, Sivalls & Bryson, Inc., has established a Venezuelan division with offices in Caracas, Maracaibo and Anaco.

Allen Pike has been appointed manager of the newly organized division. Pike has been oil representative for BS&B oilfield equipment in Venezuela. Eugene L. Seale has been appointed branch manager of the Anaco Branch which will serve eastern Venezuela, and James H. Clayton has been named branch manager of the Maracaibo branch serving western Venezuela.

Hercules Motors Assigns Downey to Western Division

Hercules Motors Corporation announces the assignment of Lawrence G. Downey to direct western activities from its headquarters in Los Angeles.

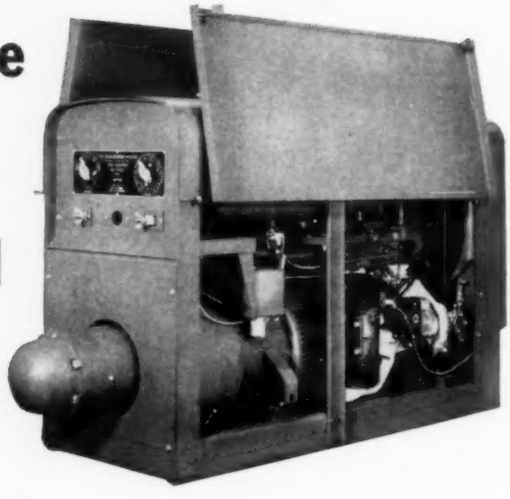
Lawrence Downey

Downey will supervise the development of sales of Hercules engines as well as distributor and dealer sales and service in 11 western states, Canadian western provinces and Alaska. Downey joined Hercules in 1940 as a sales engineer. In 1942 he served in the manufacturing department and returned to the sales again in 1946. Before coming to Hercules, he began his career in sales with the Buda Company, now a division of Allis-Chalmers.

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Lay more pipe per day with the improved 6090



Your old friend, the S-6090,
has some improvements that will help
you break more pipeline records for speed and low cost.

Now designated K-6090 this new welder offers

- **Increased horsepower** for long life of maximum output
- **Larger fuel tank** to run a 14-hour shift without refueling
- **More precise controls** to simplify selection of current and arc characteristics
- **Heavier body** to give greater protection against rugged field abuse

plus other features that make maintenance easier. For specifications and details write us!

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The World's Largest Manufacturer of Arc Welding Equipment

LINCOLN

THE LINCOLN ELECTRIC COMPANY • DEPT. 5102 • CLEVELAND 17, OHIO

D. T. Ottinger

D. H. Carson

Jones & Laughlin Announces Eight Changes in Field Forces

Jones and Laughlin Supply Division announces the appointments of three regional managers and five district sales managers as a part of reorganizing the field sales force.

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Mason-Neilan Names McAlear Manager of New Sales Division

James M. McAlear has been appointed manager of the new Instrument Sales division of Mason-Neilan. McAlear was formerly manager of the Mason-Neilan Pulp and Paper Mill department. In his new position McAlear will supervise the sale of the complete Masoneilan Instrument line.

H. P. Fishwick has been made the new head of the Pulp and Paper Mill department succeeding McAlear. Fishwick had been supervisor of sales and service engineering for paper machine drying and drainage systems.

ALCO Products Appoints Ray Loesby Northwest Agent

ALCO Products, Inc., announced the appointment of Ray Loesby as the company's agent in the Northwest for ALCO-TWIN finned-tube heat exchangers and related products.

Loesby will handle finned-tube heat exchangers and immersion, tank suction and line pressure heaters built by ALCO. His territory will comprise Washington, Oregon, Idaho and western Montana. Loesby has been a sales representative in the northwest for seven years. He is experienced in process plant design and operation, product research and development, and in sales research.

Eugene Lepkowski Appointed Square D Company Controller

Eugene Lepkowski has been appointed controller of Square D Company's newly formed Assembly division. Formerly a staff assistant to the controller of Square D's Distribution Equipment division, Lepkowski joined the company in 1956. He will headquarter in Detroit and handle the accounting activities in assembly plants in Atlanta, Dallas, Lexington, Ky., and Secaucus, N. J.

Smithco pioneered the development of this rugged cooler for severe application. Its functional design, with *excess* cooling capacity, has met and overcome *every challenge* of extreme weather and operating conditions.

The "D" series cooler, latest in the growing tradition of fine Smithco Air Coolers, combines years of qualified engineering experience with the newest manufacturing methods to give you the most dependable unit in it's field.

Their reputation for dependability has attained for Smithco coolers industry wide usage and universal recognition.

Plant & Offices — Tulsa, Oklahoma

P. O. Box 3217

Representatives in the Petroleum Industry

SMITHCO Engineering Inc.

For more data on advertised products, use Readers' Service Cards, last page.

Burgess-Manning Announces Two District Appointments

J. A. Kolb has been named sales engineer in the New York district offices, and Louis G. Halla has been appointed sales engineer for the Chicago district office for the Burgess-Manning Company, Industrial Silencer division.

Kolb has served the past three years as field sales engineer in the Chicago area. Halla previously was associated with Walker Process Equipment, Inc., and Wallace & Tiernan, Inc.

Allis-Chalmers Announces Appointment of E. F. Greiwe

Allis-Chalmers announces the appointment of E. F. Greiwe as manager of the Norwood Works Centrifugal Pump department. Greiwe succeeds M. L. Murdock, who resigned.

Greiwe has been with Allis-Chalmers since 1936 and since 1955 he has been manager of product sales, Electrical department, Norwood Works. Murdock had been manager of Norwood since 1949.

Van Valkenburg Appointed Director of New Division

E. J. Van Valkenburg will assume the position of director of the newly organized Procurement and Material Service division of ALCO Products, Inc.

Van Valkenburg, who has been with the company for 37 years, will supervise procurement, warehousing, inventory control and distribution of obsolete materials, supplies and equipment. Among his responsibilities will be analysis services for ALCO's four product divisions.

Thomas H. Pike

John E. Chumbley

Thomas Pike, John Chumbley Named Division Vice Presidents

Thomas H. Pike and John E. Chumbley have been named division vice presidents, and F. E. MacDonald has been appointed controller for Tube Turns.

Pike will be in charge of planning, and Chumbley will head general sales operations for the division, manufacturer of welding pipe fittings and flanges and custom forgings.

Pike joined Tube Turn in 1940 as district manager in Los Angeles, was promoted to assistant manager at the main office in 1945 and became merchandising manager in 1955. Chumbley has been with the company since 1937. He became assistant general sales manager in 1953. MacDonald, who has been with the firm since 1937, was made assistant controller in 1945.

BS&B International Announces Opening of Venezuela Division

BS&B International, S.A., a wholly owned subsidiary of Black, Sivalls & Bryson, Inc., has established a Venezuelan division with offices in Caracas, Maracaibo and Anaco.

Allen Pike has been appointed manager of the newly organized division. Pike has been oil representative for BS&B oilfield equipment in Venezuela. Eugene L. Seale has been appointed branch manager of the Anaco Branch which will serve eastern Venezuela, and James H. Clayton has been named branch manager of the Maracaibo branch serving western Venezuela.

Hercules Motors Assigns Downey to Western Division

Hercules Motors Corporation announces the assignment of Lawrence G. Downey to direct western activities from its headquarters in Los Angeles.

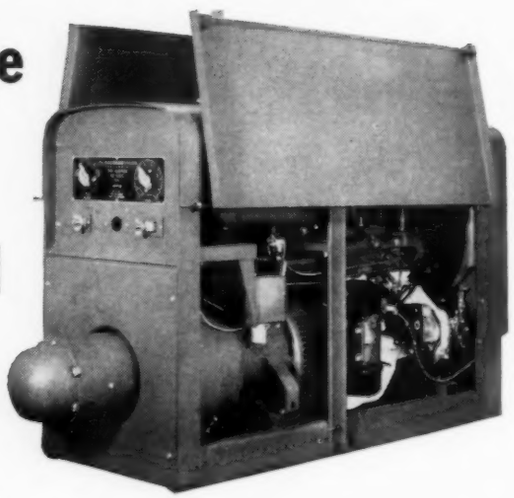
Lawrence Downey

Downey will supervise the development of sales of Hercules engines as well as distributor and dealer sales and service in 11 western states, Canadian western provinces and Alaska. Downey joined Hercules in 1940 as a sales engineer. In 1942 he served in the manufacturing department and returned to the sales again in 1946. Before coming to Hercules, he began his career in sales with the Buda Company, now a division of Allis-Chalmers.

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Lay more pipe per day with the improved 6090



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Representatives in the Petroleum Industry
SMITHCO
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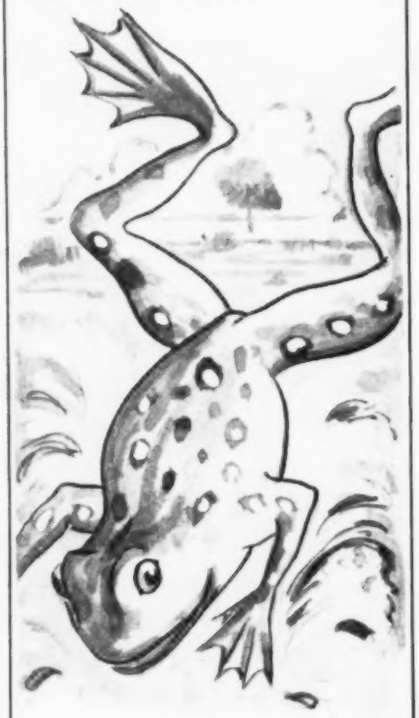
YOU'RE THE
BIG
FROG
IN OUR POND!



It's better to be a BIG frog in a little pond than a LITTLE frog in a big pond.

We have no *unimportant* customers, whose orders stand by while bigger accounts get service preference. Yet we're big enough to handle any job.

Do business where *your* business is important. For pipe, casing, pipeline supplies, pontoons, piling, field welding . . . call on KANE . . . and get "big frog" attention — every time.

PIPE for every purpose

Convenient location for prompt delivery in the Gulf, or to any major oilfield.

KANE
BOILER WORKS, INC.
311—27th, Galveston, Texas
Phone SO 3-2401 Houston: CA 2-7759

Cleveland Trencher Appoints Assistant General Manager

The Cleveland Trencher Company announces the appointment of Raymond E. Orton as assistant general manager. Prior to his appointment with Cleveland Trencher Company, Orton was manager of engineering in the Automatic Transportation division of Yale and Towne Manufacturing Company. Previously he had been treasurer and general manager of the Orton Crane and Shovel Company for nine years. He also worked 10 years as chief engineer of Acme Steel Company.

Raymond E. Orton

Paul Des Jardins Promoted By Worthington Corporation

Paul Des Jardins has been appointed manager of the New Products and Marketing Planning department of Worthington Corporation. Des Jardins will be responsible for planning and integrating marketing programs of separate product divisions of the corporation. He has been with the company since 1938 and in 1954 became manager of the Petroleum and Chemical Sales department.

Shand and Jurs Company Opens New Office in Cleveland

Shand and Jurs Company announces the appointment of J. J. Connelly as manager of the newly established sales and engineering service office in Cleveland's Terminal Tower Building.

Connelly will also be available for customer engineering service as concerns the mechanical and electrical products made by Shand and Jurs. Connelly has had four years of experience in the Shand and Jurs products line. The office was opened to give better service to customers in Ohio, Michigan, western Pennsylvania and West Virginia.

J. J. Connelly

FOR SALE
MODERN OFFICE BUILDING

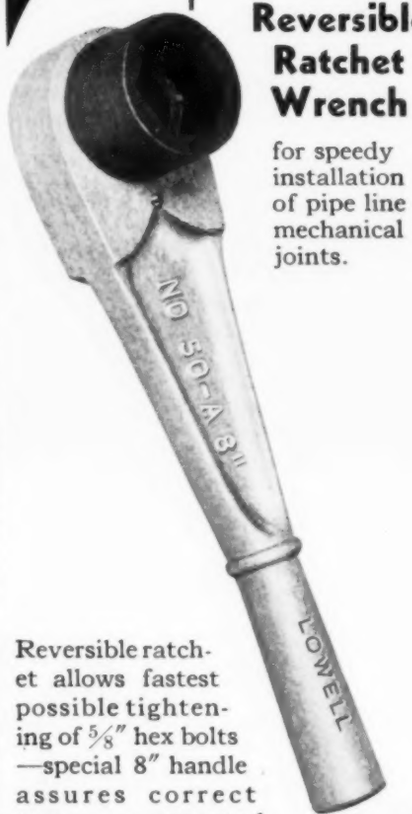
containing 9800 square feet, completely air-conditioned, at 2434 Holmes Road, Houston, Texas, with 20.70 acres (surface only) 850 feet highway frontage. Also shop buildings and pipe racks. Private railroad trackage extending entire length of tract. Ample water supply.

Gulf Oil Corporation, Houston, Texas
Call J. N. Henderson, CA 5-3141, Ext. 460

the WRENCH we made for YOU

Lowell
50-A
Reversible Ratchet Wrench

for speedy installation of pipe line mechanical joints.



Reversible ratchet allows fastest possible tightening of 5/8" hex bolts —special 8" handle assures correct torque, as suggested in American Standard Specifications.

Ask your local industrial distributor for the #50-A Wrench by *Lowell* – makers of industrial wrenches for more than 85 years

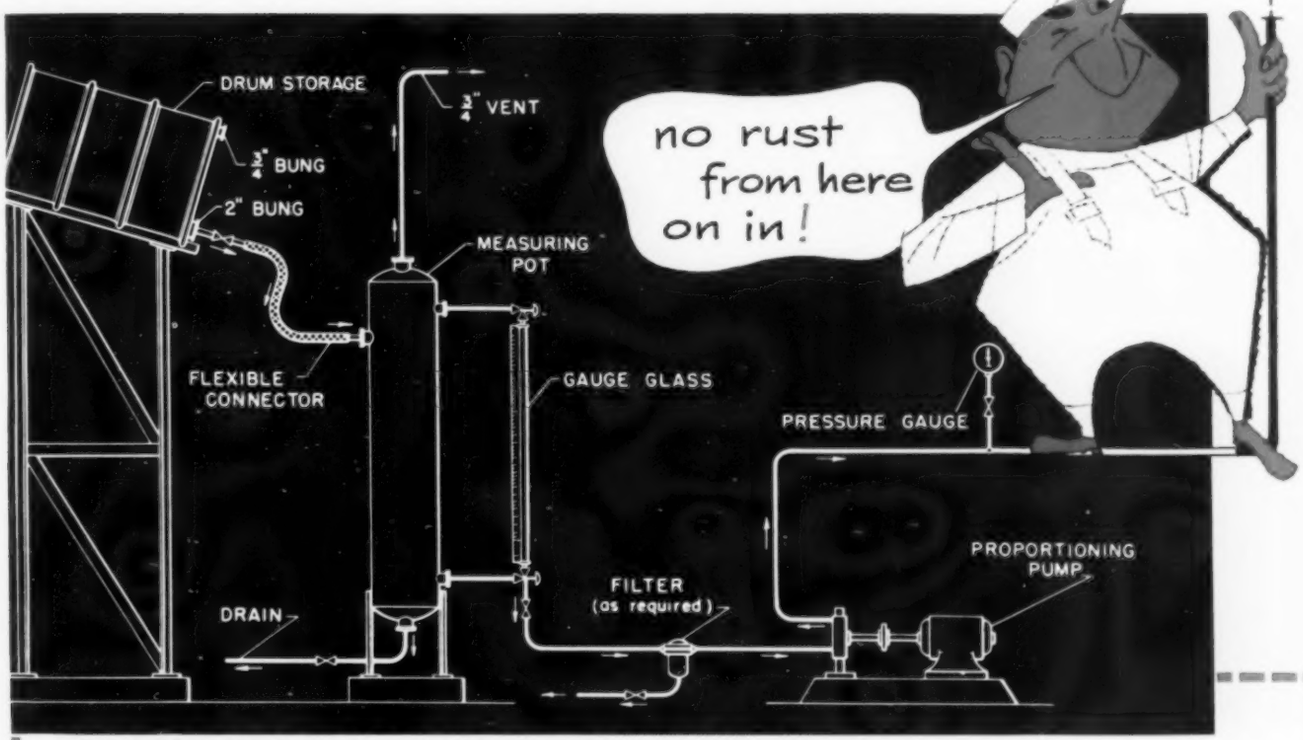
or write direct to

LOWELL WRENCH CO.
WORCESTER 8, MASS.

If it's a question of corrosion...

UNICOR®

...is the answer



This is a flow chart showing how the Unicor Automatic Injection System works for you.

Question: *How can we eliminate serious filter fouling in blending tank caused by formation of highly peptized iron rust during processing?*

Answer: UOP's Unicor corrosion inhibitor solved this problem for a large southern refiner not long ago. Before Unicor application, a yard-square panel of the tank interior was sandblasted down to bare metal to test Unicor's effectiveness. After several months of injection in the rundown line, this test panel was completely free of corrosion, the remainder of tank interior was free of filter-fouling rust.

Question: *Is addition of water necessary?*

Answer: No. Unicor is oil soluble. It also prevents rusting caused by unavoidably entrained or dissolved moisture.

Question: *Should Unicor be injected only in the rundown line?*

Answer: Unicor can be injected at any point in your process. The refiner mentioned above shifted the Unicor injection point from the rundown line to his crude fractionator overhead and in catalytic gasoline from the main column overhead receiver. This extended Unicor's protection to heat exchangers, condensers and towers between new injection points and blending tank. Unicor inhibits corrosion in all your processing equipment from the point of injection on . . . even to consumer equipment.

Question: *How much does Unicor cost?*

Answer: About $0.001 or a tenth of a cent per bbl. of product in normal application.

Let us send you samples of

UNICOR

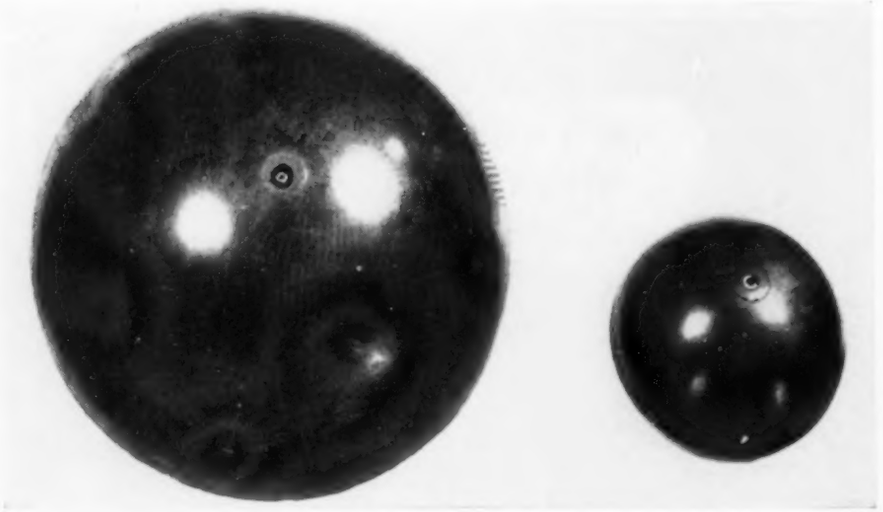
for testing in your own laboratories.

UOP®

UNIVERSAL OIL PRODUCTS COMPANY
30 ALGONQUIN ROAD
DES PLAINES, ILLINOIS, U.S.A.

For more data on advertised products, use Readers' Service Cards, last page.

What's New in EQUIPMENT



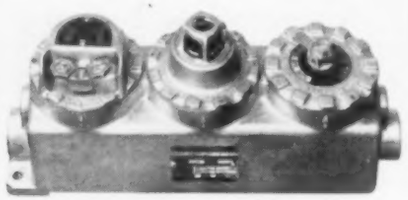
Pipe Line Sphere

The F. H. Maloney Company announces a pipe line sphere which is a liquid filled, rubber sphere designed to operate in all products lines where an intermediate seal to transmit pressure is desired. The sphere is especially designed for product separation and calibration of meter loops in products lines, but it has also been found excellent in other applications such as water removal and products removal.

Extensive laboratory and field tests, in operating products lines, have established that the spheres will withstand runs of 500 miles and more before wear becomes excessive. It also lends itself to automation around compressor and pump stations. It is flexible in use and follows the flow through sharp radius bends.

The spheres require no maintenance or assembly other than proper sizing of actual operating diameter, which is controllable in the field. Sizes presently available are: 4, 6, 8, 10, 12, 14, 16 and 20-inch. Additional sizes are being designed.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Condulets

Crouse-Hinds Company announces a new EWC series of control station and pilot light condulets of threaded joint construction that can be used indoors or out.

Explosion of dust ignition proof, weather resistant and rain tight, the new condulet series features an aluminum cover with feraloy housing. Joints of the cover opening, operating shaft and pilot light jewel are sealed with neoprene O-rings.

The series is available in one, two and three gangs, push button stations, pilot lights and selector switches.

For more data, circle **No. E2** on Deaders' Service Card, last page this issue.

Robotarm Actuator

Research Engineering Company announces the Robotarm valve actuator, a rugged and compact low cost gas or fluid operated actuator for operation of plug valves and other 90 degree rotating mechanisms.

Robotarm employs a totally enclosed piston rack and gear assembly fully submerged in an oil bath. Field installation to any standard wrench operated valve can be made in a matter of minutes with the Robotarm adjustable mounting bracket.

A square recess is provided in the bottom of the rotating gear shaft which facilitates the Robotarm's being placed over and adapted to the average plug valve stem. Accessories include component pneumatic or solenoid operated pilot valves and other items mounted to the Robotarms at the factory for package unit assemblies.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Lincolnweld

The Lincoln Electric Company presents a mechanized welding machine for the submerged arc process extending advantages of high speed and low cost welding. The Lincolnweld ML-3 provides automatic wire feed, flux flow and travel speed and permits manual guiding of the welding arc.

The unit feeds a continuous wire electrode from a coil to a compact hand-held gun which is held against the joint along which it is propelled at a preset speed by a small motor. A low pressure air system flows flux from a large tank to the gun from which it drops to completely cover the arc at all times.

The Lincolnweld is designed to improve the application of the submerged arc process, extending its use and reducing the cost of many jobs. Speeds up to 70 inches per minute using up to 600 amperes are possible with this manual, mechanized unit.

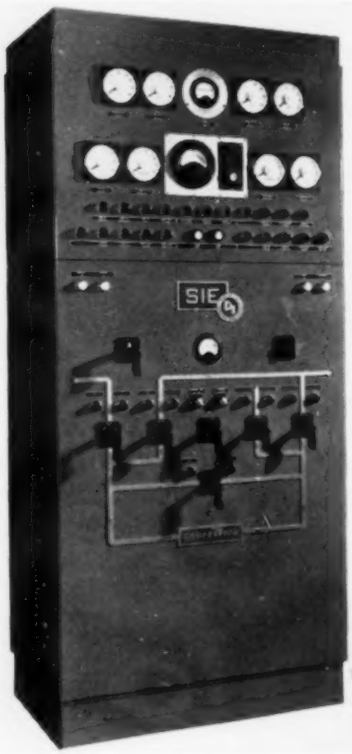
For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Tool Chest

Scott-Rice Co. announces an all-welded 18-gage steel tool chest for storage of tools, equipment, clothing and extra stock for job-site workmen.

The chest is available in two sizes and heavy enough to discourage easy removal. An extended flanged sloping top provides complete weather protection. A steel slot for "handle" tools permits storage of six tools which cannot be removed when top is locked. Removable trays and the shovel slot with angle irons are optional features. Angle iron for stilt mounting to allow full truck bed capacity is available. Chest height does not restrict the driver's rear mirror vision.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

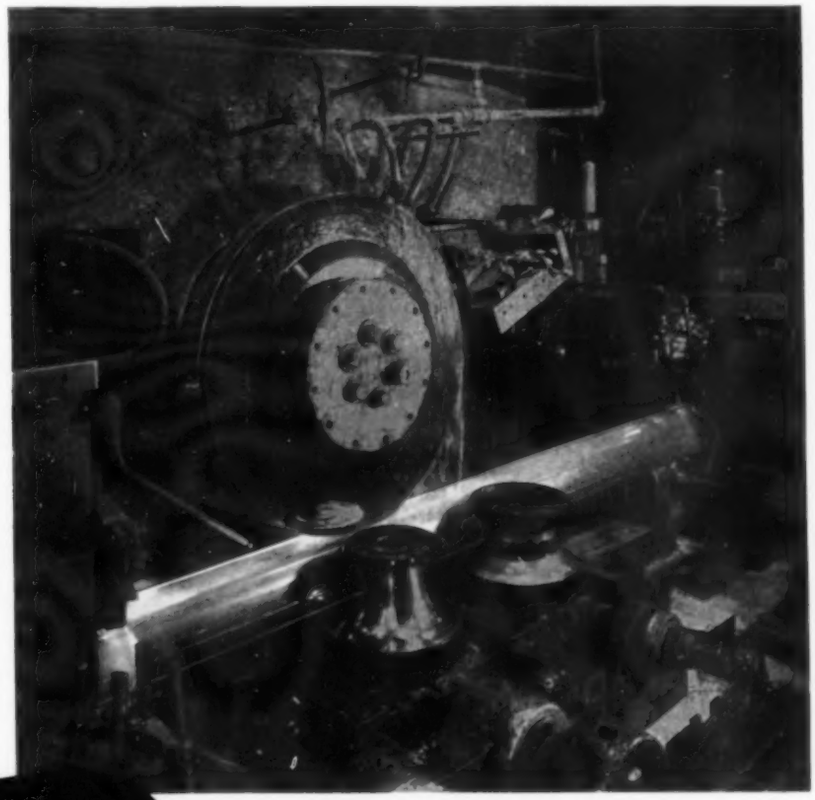


Start Unit

SIE announces a new compressor start unit which sequences all yard, compressor and auxiliary valves automatically. The unit will start and bring on line a compressor on receipt of a single actuating signal. It permits highly efficient semi-automatic operation of a compressor station from the control room. Not only is compressor control achieved through automatic sequencing of valves and solenoids but the CSU-I displays instant indications of measurements and functions. Alarm operation and automatic shutdown occur when safe operating parameters are exceeded, or on failure of proper starting events. Appropriate warning signals are given simultaneously for transmission to the dispatch office.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

HIGH QUALITY OF Acme-Newport LINE PIPE* ENSURES TROUBLE-FREE INSTALLATION AND SERVICE



***SIZES AND WEIGHTS AVAILABLE**

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

ECONOMICAL WATERAIL-TRUCK DELIVERY

This Company is ideally situated on the Mississippi-Ohio River system and the great Cincinnati rail-truck hub. River barge facilities, 7 major railroads and 143 motor carriers enable Acme-Newport to give economical, dependable delivery to the entire area of the Middle West and South.

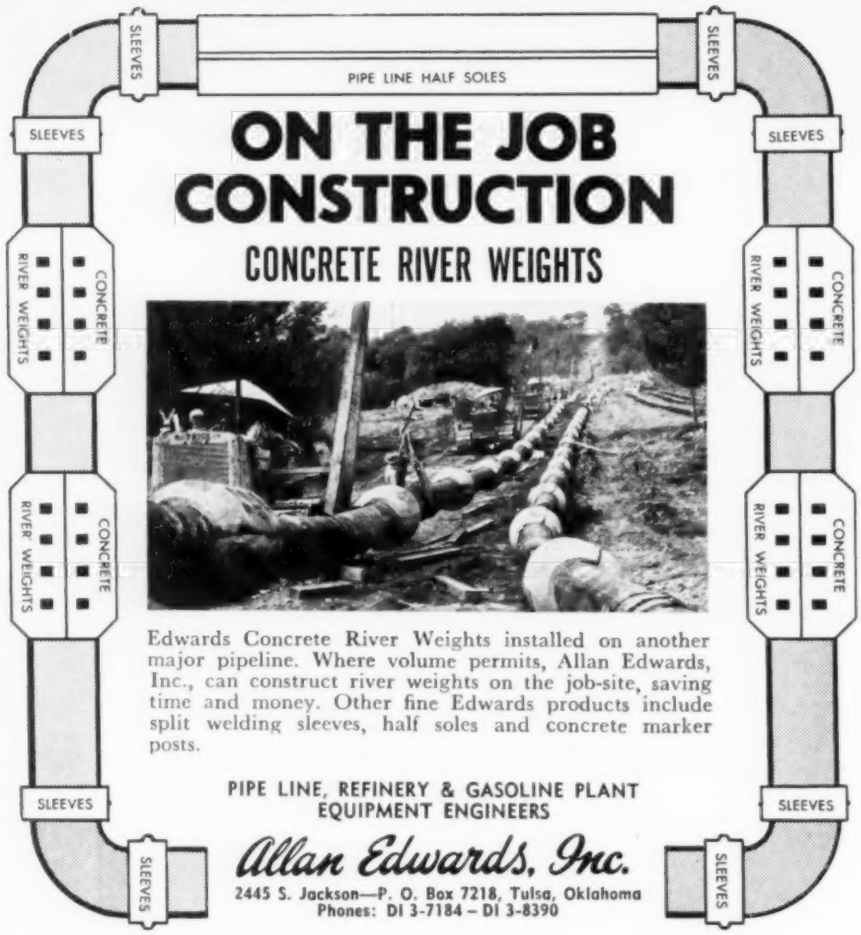
Electric weld line pipe from Acme-Newport meets your specifications, because every stage of its production is closely supervised. This 73-year-old basic steel producer has the advantage of modern facilities plus well-trained, conscientious personnel determined to provide complete customer satisfaction. The result is line pipe of excellent steel, always true round and uniform in wall thickness, that bends and welds easily, lines up properly, gives trouble-free installation and years of uninterrupted service in the field.

For 4" and 6" sizes, standard or thin wall, look to Acme-Newport.

Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY



ON THE JOB CONSTRUCTION

CONCRETE RIVER WEIGHTS

Edwards Concrete River Weights installed on another major pipeline. Where volume permits, Allan Edwards, Inc., can construct river weights on the job-site, saving time and money. Other fine Edwards products include split welding sleeves, half soles and concrete marker posts.

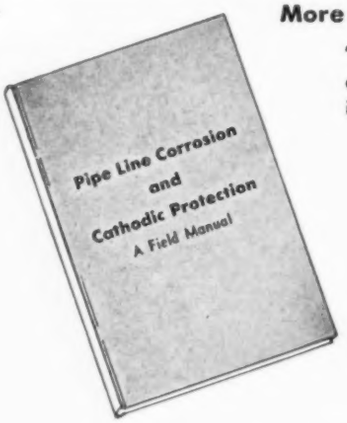
PIPE LINE, REFINERY & GASOLINE PLANT EQUIPMENT ENGINEERS

Allan Edwards, Inc.

2445 S. Jackson—P. O. Box 7218, Tulsa, Oklahoma
Phones: DI 3-7184 – DI 3-8390

More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."



Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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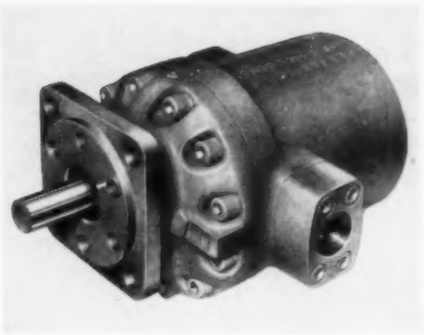


Hydraulic Pump

Berry Hydraulics has introduced a new series of hydraulic pump motor units, designed specifically for 2,000-3,000 psi industrial service. The model A series is a modification of Berry Motor pump units widely used in oil, gas and other industries, with the design simplified to provide general industry with rugged, high pressure motor pump units at relatively low cost. They may be flanged or foot-mounted.

When used as pumps, they are for continuous operating pressures of 2,000 psi, with surge pressures to 3,000 psi. Pumps come in capacities from 7.5 to 12 gpm at rated speeds of 1,200 rpm.

The same units can be used as motors. Instantly reversible, the motors will carry overhung chain or belt loads. High torque at slow speeds allows direct connection without gear or belt reductions.

(This item supplements Berry Hydraulics data on Pages 56-57 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Magnetic Seal

A new magnetic seal has been introduced by the A. W. Chesterton Co. The simple seal has just two working parts held together by magnetic force. This force retains an even pressure on the optically flat sealing surfaces regardless of the operational pressures. A seal is formed between self-lubricating carbon and Alnico metal lapped faces which is very tight.

The seals can be used to replace conventional packing or spring loaded mechanical seals in pumps, compressors or on any rotary shaft where liquids, gases or corrosives are to be sealed. The seal's magnetic ring is sealed to the gland by an external resilient O ring. The ring with the self-lubricating carbon face is sealed to the shaft by an internal flexible O ring. When placed on the shaft the seal is held by magnetic force and positions itself in the stuffing box without calculations. There is no breaking-in period and the seal remains tight indefinitely.

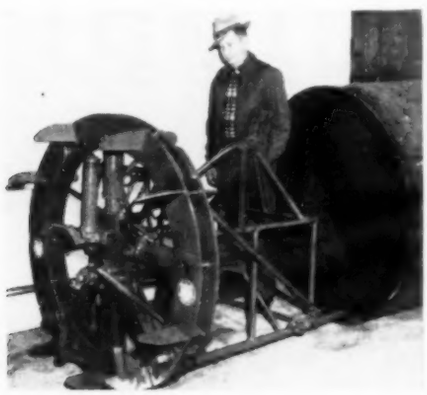
For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Fire Extinguisher

Fire King Corporation introduces a dry chemical fire extinguisher ideal for oil and gas well or pipe line fires. The extinguisher, which comes in three different sizes and can be reloaded in a minute's time, sprays an extremely fine powder over the fire. The heat from the fire causes a chemical reaction that releases a carbon dioxide gas cutting off oxygen and smothering the flame instantly.

The dry chemical extinguishers can be used on electrical fires because the chemical is a non-conductor of electricity. Pictured above are two extinguishers, the 8-pound model, on the left, and the 15-pound model. Not pictured is the Number 200, used for large fires. The dry chemical will never harden under any conditions and will always be free flowing, even in sub-zero temperatures. The efficient nozzle on the extinguisher expands the dry chemical in a ratio of 1,100 to 1.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

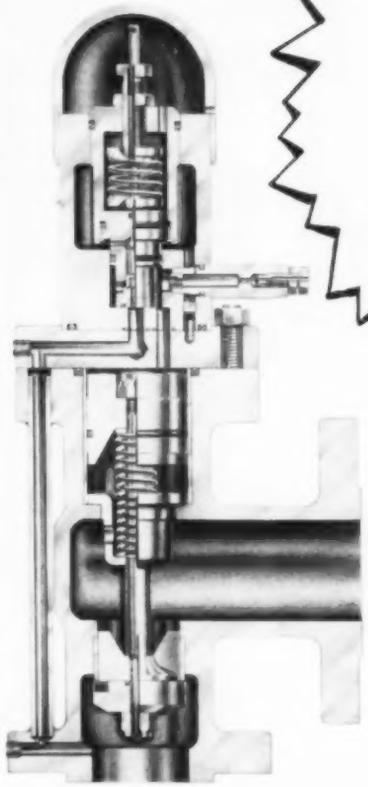


Line-Up Clamp

The largest internal hydraulic line-up clamp built to date is shown above. M. J. Crose Manufacturing Company built it to handle 55-inch pipe such as shown in the picture. An average size man is inspecting the new product to help show the giant size dimensions of this clamp and its heavy construction. It was designed and constructed for a special pipe line project, but Crose makes smaller hydraulic type clamps for more conventional sizes of pipe.

(This item supplements M. J. Crose Manufacturing Company data on pages 104-105 of the Pipe Line Composite Catalog, 1st Edition).

For more data, circle **No. E10** on Readers' Service Card, last page this issue.



INSTANTANEOUS OPENING FOR GAS OVERPRESSURES

MODEL 416 RELIEF VALVE ASSURES POSITIVE PROTECTION

The new pilot operated Kinzbach Model 416 Relief Valves were designed to be the most dependable relief valve for gas services. Whenever line pressure reaches set pressure the pilot valve opens and full line pressure is applied to the main valve, opening it through its full stroke without pressure accumulation.

This flat-seated pilot valve has a stainless steel loading spring which makes possible an extremely accurate set pressure and years of trouble-free performance. Some other advantages of this simple and rugged valve include its positive leakproof seating, easy functional testing below set pressure, and convenient bench setting for both opening and closing pressure. The Model 416 Valves are Certified under A.S.M.E. Unfired Pressure Vessel Code (Sec. VIII, Par. UG-131).

For complete details on this and other Kinzbach Relief Valves, write for new catalog.

KINZBACH TOOL CO INC

KINZBACH TOOL CO., INC.
P. O. Box 277 • Houston, Texas

EXPORT OFFICE:
74 TRINITY PLACE
NEW YORK, N. Y.

For more data on advertised products, use Readers' Service Cards, last page.

130,000 lb.
Model PBI-24BH Sideboom for
TD-24 Tractor. Increased Lifting Capacity—130,000 lb. using maximum cwt.
72,500 lb.
Model SBI-182BH Sideboom for
TD-18 Tractor. Increased Lifting Capacity—72,500 lb.
FIVE outstanding

that give you greatest pipe-handling

These five International Superior sidebooms with increased lifting capacity give you the greatest pipe-handling ability for your equipment dollar in their respective classes. There's a machine for every job, every operator—the TD-9 for utility work, the TD-14 and TD-18 for average jobs, and the instant-shifting, power-steered TD-24 for mainliners.

And look at the profit possibilities you get with exclusive International Superior features...

- International Superior booms put as much as 14% less poundage psi on tracks than other makes using same width shoes and standard counterweights. You get a mud-beating margin of flotation, and extra traction that easily handles big pipe loads on slopes and boggy ground.
- Fleeting sheaves on boom and load lines prevent cable from piling and crushing on drums, thus increasing cable life and operator safety.
- Gear-type splines drive drum clutches—no keys to break and cause delay.
- Reach-easy controls in vertical cluster (with horizontal lever travel on some models) for operator convenience and safety.

42,700 lb.
Model SBI-182 Sideboom for **TD-18** Tractor. Increased Lifting Capacity—40,950 lb. With Blade Backfiller—42,700 lb.

35,250 lb.
Model SBI-142 Sideboom for **TD-14** Tractor. Increased Lifting Capacity—33,575 lb. With Blade Backfiller—35,250 lb.

19,500 lb.
Model SBI-91 Sideboom for **TD-9** Tractor. Increased Lifting Capacity—18,000 lb. With Blade Backfiller—19,500 lb.

g performers

capacity per equipment dollar...

Individual drum shaft mounting on TD-24, TD-18, and TD-14 keep cable properly aligned with a center boom cable pull that prevents piling.

Remote mounting of shift lever simplifies selection of proper sideboom transmission gear.

Box frame shield for load line protects operator.

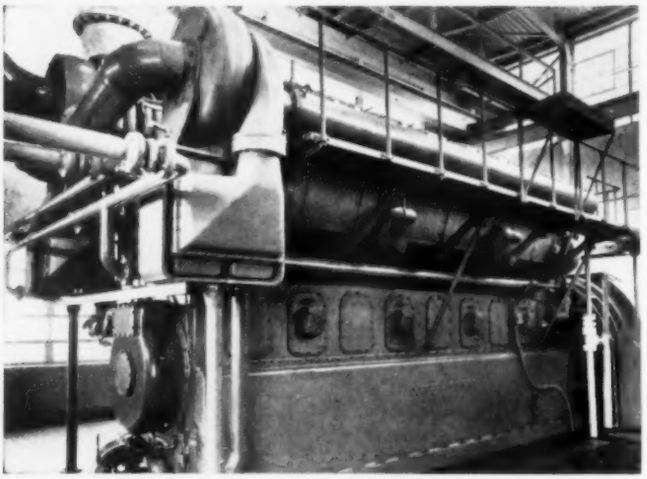
Non-slip, jaw-type drum clutches, with power both up and down, assure direct clutch alignment and increase operator safety.

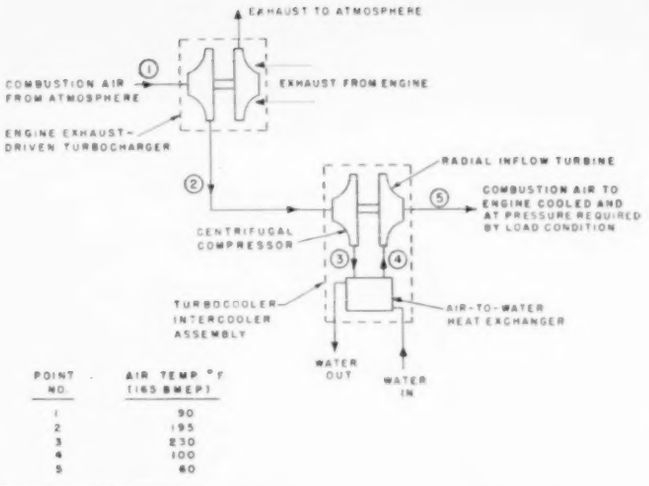
You can see what these boom capacities and operating features mean in increased operator production and performance on your jobs. Let your International Superior distributor show you how to add to your pipelaying profits.

International Harvester Company, Chicago 1, Ill.

INTERNATIONAL®
SUPERIOR®

For more data on advertised products, use Readers' Service Cards, last page.





POINT NO.	AIR TEMP °F (165 BMEP)
1	90
2	195
3	230
4	100
5	60

LION E-120 COATING

1958 model... **MAINTAINS MINIMUM *3/32"* THICKNESS SCHEDULE**

Look at this smooth coating job. With only occasional jeeps to be repaired, it is moving ahead of schedule, at a big saving to company and contractor. For hundreds of miles this big-inch job has required less coating than estimated — with coating thickness on both top and bottom of pipe meeting contract specifications. Ease of handling and negligible patching have prevented excessive use of material or waste.

Now celebrating its sixteenth year, LION E-120 has proven its worth on thousands of miles of big-inch and little-inch lines. That's why you can be sure of lower application cost with LION E-120 coating — 1958 model.

Write for complete specifications of LION *E-120 coating and literature on other* HOLCOMBE *corrosion prevention products.*

THE **HOLCOMBE** COMPANY, INC.
FIRST NATIONAL BANK BUILDING TELEPHONE 5-3468
SHREVEPORT, LOUISIANA

HOLCOMBE COMPANY OF CANADA, INC.
323 BARKER BUILDING TELEPHONE 6-7291
CALGARY, ALBERTA, CANADA

SELENIUM RECTIFIERS GRAPHITE ANODES
PIPE WRAPPINGS LION COATINGS COKE BREEZE

Turbocooler

Turbocooling, a method for supercooling combustion air, provides an important potential for increasing horsepower output of gas or gas-diesel engines. In some cases these increases are as much as 23 percent. At the same time, reductions as high as 5.0 percent in fuel consumption are being realized, according to actual field experience.

Basically, the Cooper-Bessemer turbocooler is a turbine-driven centrifugal compressor equipped with an aftercooler. In the past, air from engine turbocharger has been throttled to the air manifold to maintain correct air-to-fuel ratio. The conventional practice has been to do this with butterfly valves. Experience has shown this practice a simple waste of energy with little, if any, effect on cooling the intake air. The introduction of the turbocooler, however, has created a practical method of utilizing an abundant source of energy created by a pressure drop in the manifold, which would further cool the combustion air going to the engine cylinders.

The cooling cycle of the new development is shown in the diagram. In this system, filtered air enters the high pressure turbocharger (1) and is compressed by the exhaust gas driven centrifugal blower (2). The pressurized air at elevated temperature from compression is then directed to a booster (3) in the turbocooler for a second stage of compression. As the air leaves the booster, its temperature and pressure are considerably higher than after the first stage of compression. This air is then cooled by an air-to-water intercooler (4) before entering a turbo-expander (5).

Since the pressure of the air entering the turbo-expander (5) is greater than the air intake requirements of the engine, a pressure drop is available through the expander to motivate the expander impeller causing the impeller to spin. As the same air expands through the impeller, its temperature is reduced by 15 to 40 degrees.

The net effect of the turbocooler is to provide the engine with cool combustion air. The more air or oxygen that can be concentrated in the cylinders, the more efficient the combustion of the fuel and the more fuel the engine can take. As a result, engines equipped with turbocooling have the advantage of higher overload capacity with less danger of detonation and less BTU consumption per brake horsepower hour.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Instrument Calibrator

Gilmore Industries, Inc. has announced a new Model 104 calibrator for calibrating instruments used with resistance type force and pressure cells, rated on a voltage output ratio basis. The calibrator is used as a substitute for the sensing element in a measuring system. The known outputs of the model 104 are utilized in calibrating, servicing, and installing indicating or recording instruments.

The model 104 is a valuable time saver for installing new systems or calibrating systems already in service.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

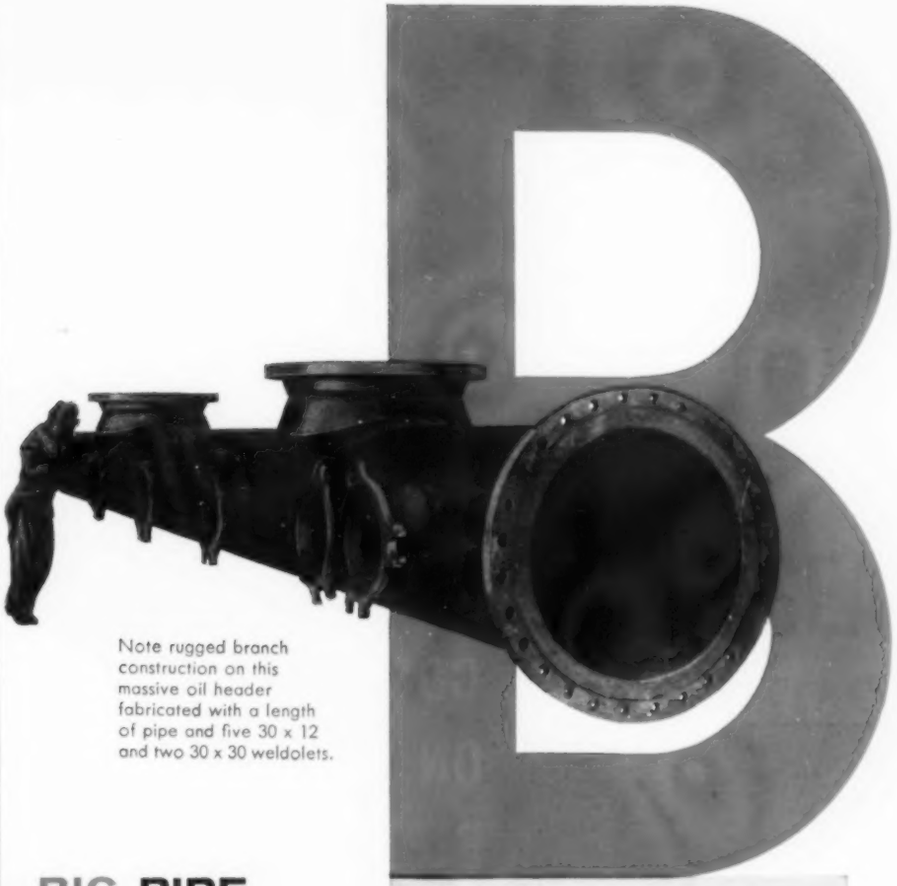
Time Switch

A program time switch with built-in tilting tabs for setting programs has been announced by Tork Time Controls, Inc. The new switch offers maximum adjustability on setting up intermittent operations, with maximum ease of setting with the new type tabs.

The Model 8001's 24 hour dial has 96 tabs attached to its perimeter. Minimum on or off time is 15 minutes, maximum is 23 hours and 45 minutes. A wide variety of on-off combinations are possible.

The tabs are easily adjusted, even with gloved or oily hands. No tools are necessary to tilt tabs or to set the Skip-A-Day selector. The setting or resetting of both minute and daily programs is a flick-in, flick-out operation, with no lost time.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Note rugged branch construction on this massive oil header fabricated with a length of pipe and five 30 x 12 and two 30 x 30 weldolets.

BIG PIPE
BIG MONEY
to be SAVED
by using
30 x 30
BONNEY
WELDOLETS

Closer manifolding, ease and speed of field fabrication without header distortion, lower purchase and welding costs are just a few of the profit benefits of header fabrication with Bonney Weldolets. Today there is particular need for reducing costs. Bonney Forge can provide this opportunity for cutting costs in your company. Write, phone or wire for details.

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WELDOLETS®
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for all services

BONNEY FORGE AND TOOL WORKS
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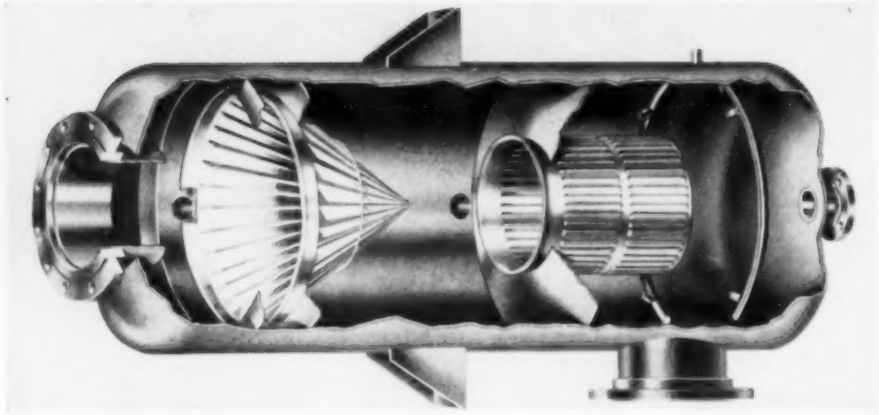
ALLENTOWN, PENNSYLVANIA



Centrifix Scrubber

The WD Scrubber, a new low cost, easy to install means of removing solid or liquid entrainment in gas or vapor, has been announced by Centrifix Corporation.

This new centrifix scrubber can be designed for any operating pressure, flow rate or temperature. It is guaranteed to remove 99 percent of such entrainment, solid or liquid, regardless of size, density or chemical characteristics. The scrubber combines Centrifix's patented washing tuyere with its patented helicoid drying tuyere to provide efficient, low cost removal of such contaminants as fly ash from boilers or incinerators, oil mists incident to food processing, vaporized oil encountered in compression of air and gases, sulfides from natural and refinery gases.

The scrubber is self cleaning, non-clogging, does the purifying job entirely by centrifugal action upon the moving gas or vapor with a minimum pressure drop.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Less Breakage at Low Temperatures
COSTS LESS ON THE PIPE
Less Breakage Near Roll Core
Less Breakage From Quick Starts
Normal Curves At Straight-line Tension

PERRAULT 15 lb. FELT Glass Fibre Reinforced

also...

Glass, Asbestos and Kraft Wrap . . . Rock Shield . . . Coating & Wrapping, Cleaning & Priming Machines . . . Tar Kettles, Patch Pots, Burners & Accessories . . . Pneumatic Inside Line-up Clamp . . . Pneumatic-tired Lowering-in Cradle . . . Pipe Cradles . . . Tongs, Sling Belts, Hooks, Clamps, Hand Tools, Supplies and Equipment of Every Sort.

Perrault fifteen-pound asbestos pipe wrap is reinforced with longitudinal glass fiber strands at one-fourth inch spacing. It costs no more delivered to the job, but by eliminating most shut-downs due to breakage, it costs far less on the pipe. Since it is not brittle when cold. Perrault reinforced felt is especially recommended for Fall and Spring Projects where material will be kept in unheated storage. Let us show you a sample and quote your next job. We also offer the best in other pipe wraps: Owens-Corning Glass, Kerr-McGee Outer Wrap, Kraft, and the original Rock Shield.

PERRAULT EQUIPMENT COMPANY

1130 N. BOSTON — TULSA, OKLA. — TELEPHONE LUther 5-1103

Corrosion Resistant PVC

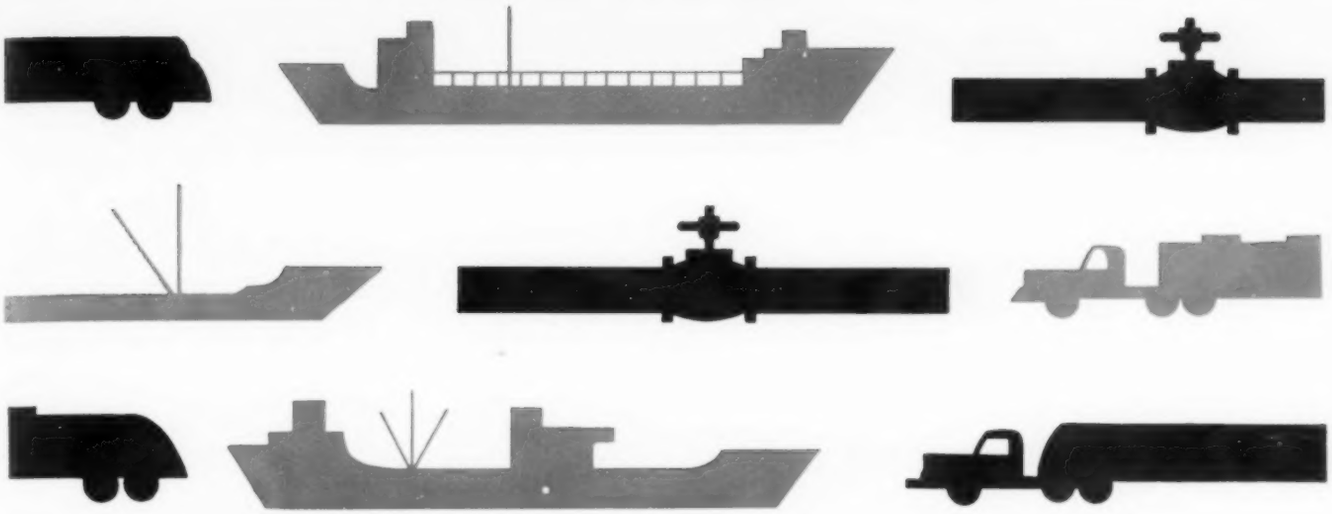
A new type of pipe combining the strength of steel with the chemical resistance of plastic is now being produced by Jones & Laughlin Steel Corporation.

This product, to be marketed under the name of "Jal-Jacket," consists of a rigid polyvinyl chloride (PVC) tube which is jacketed with an electric resistance welded steel pipe.

Polyvinyl chloride plastic was chosen as the Liner material because of its excellent and widely recognized resistance to a broad range of corrosive fluids. By using a steel jacket, the limitation of pressure common to most plastic pipe is overcome and working pressures of 1,000 psi at 150 °F. are easily attained. Jal-Jacket is so designed that the pipe-ends as well as the inside surfaces are continuously protected. Positive seal and quick make-up are provided by the use of Victaulic couplings which lock into mill-rolled grooves.

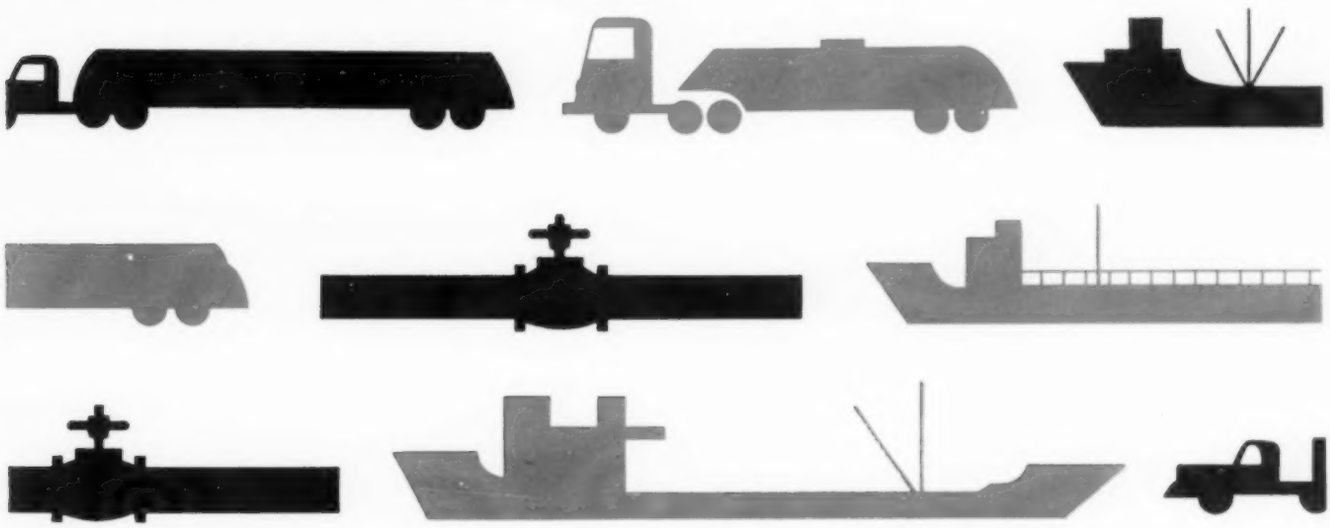
The new steel-jacketed PVC pipe will be available in 20-foot mill lengths in the 2-inch, 3-inch, and 4-inch nominal O.D. sizes. Currently, only the 2-inch nominal (two and three-eighth-inch O.D.) size is being offered but the 3-inch and 4-inch sizes will be in production by the second quarter of 1958.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.



FOR SAFE TRANSPORT-LAND AND SEA

SHAND AND JURS TANK FITTINGS



For over 35 years, Shand and Jurs has pioneered in the design and manufacture of mechanical tank fittings for truck tanks, marine tankers and pipeline installations. S&J offers petroleum transporters the world's most complete line of valves, gages, fittings and controls for maximum safety and economy in the movement of petroleum products. Convenient Shand and Jurs branch offices and sales representatives are ready now to help you with your tank fitting problems. Call them today.

SHAND AND JURS

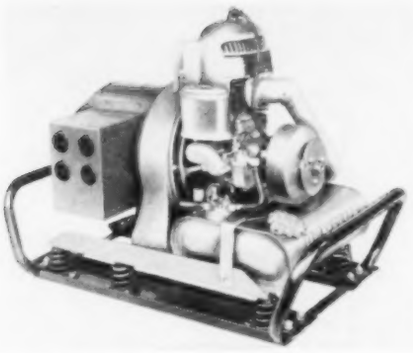
GENERAL PRECISION EQUIPMENT CORPORATION GPE

2600 Eighth Street, Berkeley, California
Branch offices and representatives in principal cities

4408

For more data on advertised products, use Readers' Service Cards, last page.

W-K-M ASA GATE VALVES...
Leader in Service, Economy and Efficiency for Oil and Gas Pipe Lines Throughout the World...
W-K-M
DIVISION OF acf INDUSTRIES INCORPORATED
PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS
MANUFACTURERS OF W-K-M GATE VALVES acf LUBRICATED PLUG VALVES
KEY-CAST ALLOY STEEL PIPING FITTINGS KEY RETURN BENDS AND FITTINGS
W-K-M IS A REGISTERED TRADEMARK OF ACF INDUSTRIES, INCORPORATED
W K M Co
HOUSTON TEXAS
U S A
STEEL



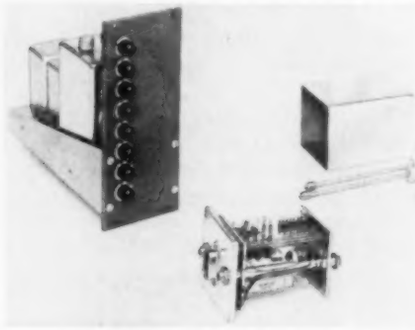
Engine-Driven Generators

Homelite has announced two new 3,000 watt, gasoline-engine-driven generators specifically designed for use by contractors and builders. The new units, the 115 volt, 60 cycle Model 8A115 and the 115/230 volt, 60 cycle Model 8A115/230, provide a dependable source of power for operating electric drills, concrete vibrators, floodlights and other power tools on the construction site.

Weighing only 140 pounds these units are portable. Both generators feature 4 percent voltage regulation and a generous overload capacity to assure top performance, less maintenance and longer life for power tools. Exclusive generator design eliminates DC brushes, commutator and DC armature windings to reduce maintenance costs. A Homelite 2-cycle gasoline engine, directly coupled to the armature shaft, provides the power.

(This item supplements Homelite data on pages 224-225 of the Pipe Line Composite Catalog, 1st Edition).

For more data, circle **No. E16** on Readers' Service Card, last page this issue.



Automatic Alarm

The Moore Associates, Inc. has introduced a new automatic alarm and control system for industry. Named Monitron, the device gathers alarm and control data from remote stations in pipe line and petroleum plants. Monitron transmits the data to a central station over wire or radio for visual and aural presentation.

It is an all electronic product using transistors and diodes for reliability, compact construction, and low power consumption. It has no moving parts and is constructed on a unique steel framework held in position by large through-volts and housed in a sealed steel case.

Monitron scans all the alarm or data points in a network at a predetermined rate ranging from two-tenths of a second per step to a twenty-thousandth of a second per step. It picks up alarm conditions from a switch closure and transmits the information back to a supervisory station to alert workers.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

STOP Entrainment Losses

IN

Petroleum Refining
Gas Processing & Transmission
Chemical Processing
Food Packing & Canning
Pharmaceutical Manufacturing
Power Plants • Steam Generation
Steel Mills • Sintering Plants
Incinerators • Garbage Disposal

WITH

Centrifix®
WD SCRUBBER

GUARANTEED TO REMOVE 99.5% OR MORE

of ALL solid or liquid entrainment in gas or vapor

- regardless of entrainment density, chemical characteristics or size (even 1 micron or smaller).
- regardless of pressure, temperature or flow rate of the flowing medium.

LOW COST • SAVES SPACE
NO MOVING PARTS
NO MAINTENANCE NEEDED
EASY TO INSTALL
SELF-CLEANING • NON-CLOGGING
MINIMUM PRESSURE DROP

AA-7279

Write today for Bulletin 500.

FOR THE FINEST IN PURIFYING EQUIPMENT FOR STEAM-VAPOR-GAS-AIR

Centrifix® CORPORATION
3608 PAYNE AVENUE
CLEVELAND 14, OHIO

All Centrifix equipment is protected by U. S. Letters Patent & Patents Pending

your key to access under pressure... ANY TIME!

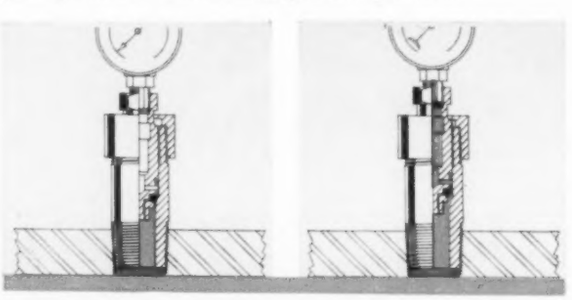
WHETHER IT'S oilfield production, refinery or pipeline application, the Cosasco Access Fitting is your key to entry against pressure—any time! With Cosasco Access Fittings you can seal off outlets but retain gaging or testing capacity... remove or replace valves or other externals... insert instruments, coupons, samplers, thermocouples and hydrogen probes without interfering with normal operations.

HOW IT WORKS. The Cosasco Access Fitting consists of three parts: a low-carbon stainless steel (Grade 303) *gage carrier plug*, a high-carbon steel *body* and a *safety ring*. In closed position (see illustrations at right), the plug primary seal presses against the tapered seat of the body, effectively blocking the flow of gas or fluid. In open position, the plug is backed off until it shoulders against the safety ring. This lifts the plug straight up from its seat and admits pressure—*but very little volume*—past the primary seal. Blocked by the O-ring secondary seal, the gas or fluid enters the plug through the by-pass holes for direct contact with gage or other external equipment.

ACCESS UNDER PRESSURE. By means of a special tool—the Cosasco High-Pressure Retriever—the gage carrier plug can be removed from the Access Fitting *under full operating pressure*. This enables the operator to gain access at will.

SAFETY. The Cosasco Access Fitting is the ultimate in safe devices for pressure readings. Only a minute volume of gas or fluid is ever admitted to the gage... yet accuracy is in no way impaired. Cosasco Access Fittings have a rated working pressure of 10,000 psi... are being successfully used at pressures in excess of this figure. Only 78 ft/lbs of torque are required to operate the gage carrier plug under 10,000 psi pressure, and the only tool needed is a standard box wrench.

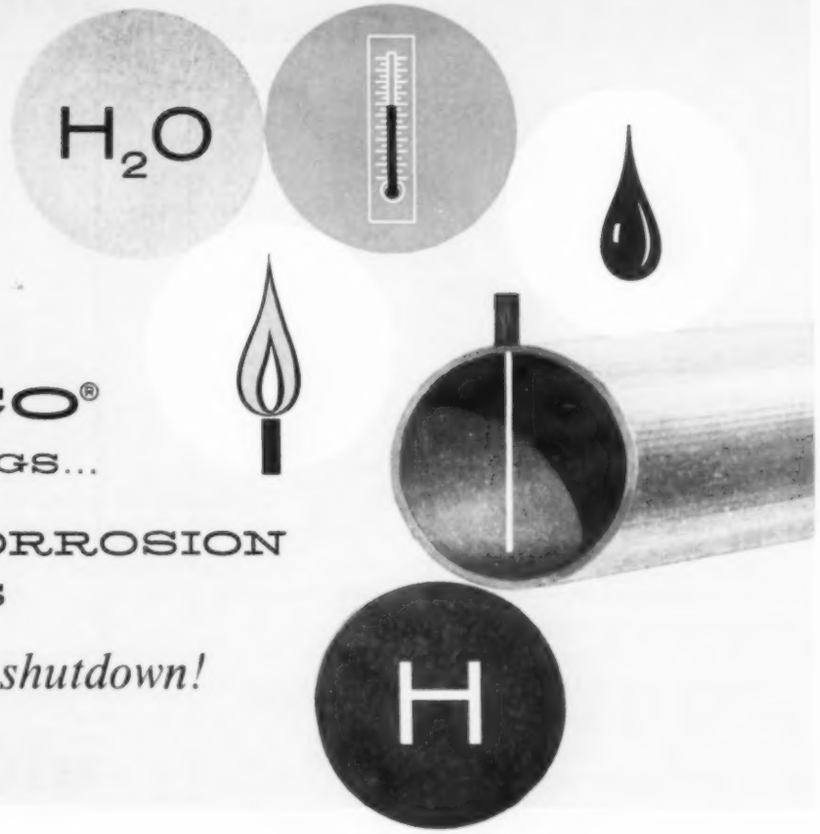
FREE CATALOG. New 32-page catalog covers Cosasco's complete line of access fittings, including applications for oilfield production, wellheads, fracturing, drilling and corrosion surveys. Write for free copy today. Or send details and blueprints and let Cosasco Engineering Dept. solve your particular access-under-pressure problem.



Access Fitting closed. Primary seal in position against tapered seat of body. Plug is never in contact with body except at straight threads... is protected from pressure, fluid, distortion, wear at all times.

Access Fitting open. Gage carrier plug is shouldered against safety ring. Pressure is admitted past primary seal through by-pass holes into hollow plug interior. Secondary O-ring provides positive seal.

COSASCO®
DIVISION
PERFECT CIRCLE CORPORATION
11655 McBEAN DRIVE, EL MONTE, CALIFORNIA
Export Office: 3631 Atlantic Blvd., Long Beach 7, California



Now...with

COSASCO®

ACCESS FITTINGS...

COMPLETE CORROSION SURVEYS

without system shutdown!

THE COSASCO ACCESS FITTING provides the key to successful corrosion survey work in transmission, storage, recovery and processing equipment. Previously, it had been difficult and costly—if not impossible—to run corrosion surveys inside pipelines and other pressure vessels without shutting down the system. Now, with Cosasco Access Fittings, corrosion surveys of all kinds can be made *under full operating pressures.*

CORROSION COUPON SURVEY. Enables the Corrosion Engineer to determine if corrosion is taking place. Grade 303 stainless steel coupon holder is installed through regular Cosasco Access Fitting body . . . can be easily inserted or withdrawn under pressure at any time. Holders are made in 3 categories adaptable to various line sizes and survey techniques. Corrosion coupons—available in standard lengths of 3″, 6″, and 8″, in any type of steel or rare metal—may be fully insulated from holders . . . remain unaffected by external soil conditions.

WATER SAMPLING SURVEY. Takes sample of line fluid for analysis. Special Cosasco water sampling plug with extension nipple and fluid catch attachment of S. S. 303 is inserted in Access Fitting body through main valve. An upper S. S. assembly consisting of a horizontal and vertical run, each with ½″ valve, is installed on the main valve. This permits taking a sample under full pressure and normal operating conditions to determine causes of corrosion.

THERMOCOUPLE SURVEY. Tells operator what part temperature is playing in corrosion problem. Cosasco thermocouple plug attachment (S. S. 303) is inserted in Access Fitting body and main valve is removed. Iron constantin wire is then pushed through gage carrier plug into position in the line. Thermocouple can be removed at will or hooked up to chart recorder for continuing temperature check.

ATOMIC HYDROGEN SURVEY. Discloses whether free atomic hydrogen is causing internal blistering. Cosasco hydrogen probe is installed through body of Access Fitting . . . can be easily withdrawn while vessel or line is on stream. Ball-check safety device protects against blowout or damage to gage should lower end of probe be damaged by excessive hydrogen in line fluid. Probe detects presence of free atomic hydrogen . . . gages rate of hydrogen diffusion.

RATE-OF-CORROSION SURVEY. Gives rate-of-corrosion reading electronically. Cosasco Corrosometer* Probe is installed under pressure through Access Fitting . . . quickly gives corrosion reading in increments of microinches without removing specimens or interfering with operations. Readings can be made in as little as 30 seconds without withdrawing the probe.

*T. M. Registered

FREE CORROSION SURVEY SERVICE

If you have a corrosion survey problem, Cosasco can help you solve it. Send details and blueprints and the Cosasco solution will be worked out promptly—at no cost to you.

FREE CATALOG. Send for new 32-page Catalog covering Cosasco's complete line of Access Fittings for Corrosion Surveys, Oilfield Production, Wellheads, Fracturing and Drilling.

COSASCO®

DIVISION

PERFECT CIRCLE CORPORATION

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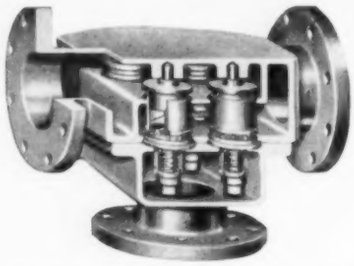
Export Office: 3631 Atlantic Blvd., Long Beach 7, California

AMOT Engine Controls



AMOT is the best known name in controls for pipe line engines, and many pipe line companies have up-dated their installed equipment with the **AMOT CONTROLS** listed below.

- **THERMOSTATIC VALVES**
  For jacket water and lube oil temperature control.
- **MECHANICAL SAFETY CONTROLS**
  Shut down engine on high water temp. or low oil pressure.
- **SAFETY CONTROL SWITCHES**
  Sound alarms on high water temperature or low oil pressure.
- **VENTED DIAPHRAGM GAS VALVES**
  Shut off main gas supply to gas engines.
- **THERMOSTATICALLY ACTUATED AIR VALVES**
  For automatic fuel change over.

AMOT MAINTAINS REPRESENTATIVES IN PRINCIPAL CITIES
CATALOG AVAILABLE ON REQUEST

AMOT CONTROLS CORP.

FIRST ST. & NEVIN AVE. RICHMOND, CALIFORNIA

Serving the Pipeline Industry

with Lincoln Arc Welding Supplies

BIG THREE
WELDING SUPPLY CO.
is happy to announce their
appointment as
WORTHINGTON
DISTRIBUTORS FOR
TEXAS OKLAHOMA NEW MEXICO

PORTABLE ROTARY AIR COMPRESSORS
(Designed for the pipeline industry)

TWIN DRILLS
CONTRACTORS TOOLS AND PUMPS
TURNING TOOLS AND
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BRANCHES
DALLAS, ODESSA, LUBBOCK, BORGER, EL PASO, LONGVIEW, ALBUQUERQUE, FARMINGTON

THE REDWASH OIL BASIN doesn't give a trencher much to dig in except hard rock, but this Cleveland 240 is making money for its owner as it grinds out trench for a flow line in rugged terrain 30 miles east of Vernal, Utah.

Good Everywhere

The CLEVELAND TRENCHER Co. 20100 St. Clair Ave., Cleveland 17, Ohio

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Protected Motors

Allis-Chalmers has published a six-page, illustrated bulletin covering its weather-protected motors which include enclosures built to NEMA Type 11 standards to meet every requirement of outdoor service.

The two-color bulletin gives construction and mechanical features of the motors which are available in all commonly used ratings, horizontal and vertical, 250 horsepower and above. Motors are available with "Silco-Flex" all-silicone-rubber insulating systems which produces stator coils that are impervious to moisture and other air-borne contaminants, highly resistant to abrasives, and thermally stable at extreme operating temperatures.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Welding Profit

"Seven Keys to Welding Profit," an eight-page, two-color booklet published by Caterpillar Tractor Company, described the Cat Twin arc-welder. Seven key factors making welding profitable, are pointed out in the booklet. Reliable Caterpillar power, two steady arcs, dual controls, parallel power, diesel economy, portability and Caterpillar dealer service are the keys to welding profits.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Demolition Tool

"Accessories for Demolition and Digging Tools" is a 24-page booklet published by Ingersoll-Rand serving as a comprehensive catalog of the company's complete line of digging tools and accessories.

The illustrated bulletin includes a useful page on reforging, sharpening and the proper method of hardening these tools.

A special section of the publication tells about Ingersoll-Rand's safety tools of forged beryllium copper to be used where sparks can't be tolerated. It describes 16 variations of the manufacturer's digging and demolition tools and 64 accessories.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Centrifugal Pumps

Centrifugal pumps designed for continuous heavy duty operation within medium pressure range are described in Ingersoll-Rand's new six-page flier. The six-page bulletin includes a complete table of pump dimensions.

Three pumps, RT, RTS and RTL units, are for general hydraulic service and suited for pipe line pumping.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Radio Equipment

General Electric's Communication Products department presents a four-page bulletin introducing the company's new line of transistorized two-way radio equipment.

The bulletin describes how the engineering advances have provided the communication industry with improved transistor-powered mobile radios. The folder explains benefits of transistorization to two-way radio users, pointing out that it provides more dependability, greater reliability, and less downtime. The equipment is specifically designed for 12-volt systems and may be used with either positive or negative ground.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Chronoflo Telemeters

Builders Providence, Inc., announces an eight-page bulletin which describes how Chronoflo telemeters enable users to observe and record the operation of widely scattered meters at a central location from any distance. The bulletin includes illustrations, schematic diagrams, performance charts and explanatory text.

It shows how the telemeter can be adapted to a wide range of industrial and municipal applications, such as metering, observing, and recording fluid flow, position, liquid level and temperature.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Automatic Controls

The Mercoid Corporation announces a 60-page catalog entitled, "Mercoid Automatic Controls for Pressure, Temperature, Liquid Level and Mechanical Movement." Catalog presents data on relays and both magnetic and tilting type mercury switches.

The book is fully illustrated and provides ordering and application information.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Tank Fittings

An eight-page data bulletin on tank fittings and accessories is available from Modern Welding Company. This is an illustrated catalog type presentation of the company's line of standard tank fittings and accessories including foot valves, flat flanges, screened air vents, quick opening tank plugs, thief hatches, emergency valves, etc.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Staynew Filters

Dollinger Corporation presents a four-page, two-color bulletin describing some of the various filters manufactured by the company. Specifications, cut-away illustrations and photographs graphically point out the advantages of the models for filters of air and other gases.

A special section is presented to explain Staynew's double action principle, applications and advantages. Simplicity, accessibility, long life and efficient operation are characteristic of the products outlined in the folder.

To get a copy, circle No. **E26** on Readers' Service Card, last page this issue.

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National Board Inspection

Pressure Vessel
Fabrication

Carbon Steel
Alloys
Alloy Clad

ROLLING CAPACITY
4" thick

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PURE COLLOIDAL CONCENTRATE

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Remove and Prevent Boiler Scale

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THE HOMOGENIZING FUEL OIL TREATMENT
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MEADOW BROOK NATIONAL BANK BUILDING
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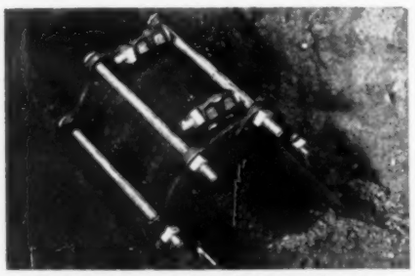
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.



SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

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Starting as a foreman over 20 years ago with the Somerville Construction Co., Pat has grown with us, until today he is vice president in charge of sales and the scheduling of all projects in both the United States and Canada. He is the man to call for information and action on your next job.

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SIGN OF SATISFACTION
TRANSMISSION LINES | DISTRIBUTION SYSTEMS

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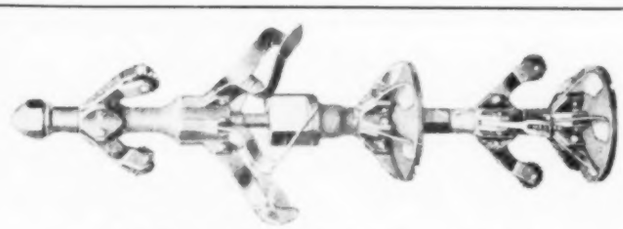
Go-Devil



Standard Model Northrup Go-Devil with leather disc drivers

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Manufacturer of
NORTHRUP GO-DEVILS & TRANSIT PIPE LINE SCRAPERS
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KONTOL 77 corrosion inhibitor

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KONTOL-clean lines require less frequent scrapings and eliminate the need for higher pump pressures (and higher maintenance costs) in order to maintain pumping efficiency. The use of Kontol 77 eliminates contamination and discoloration caused by the products of corrosion.

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BEFORE KONTOL 77. This untreated, corrosion-clogged pipe shows heavy "moss" growth and scaling.

AFTER KONTOL 77. The smooth interior surface of this Kontol-treated pipe means improved "C" factor, restored throughput.

KPL-58-3

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